

**Before the
Federal Communications Commission
Washington, D.C. 20554**

In the Matter of)	
)	
Emission Mask Requirements for Digital)	PS Docket No. 13-209
Technologies on 800 MHz NPSPAC Channels;)	RM-11663
Analog FM Capability on Mutual Aid and)	
Interoperability Channels)	

REPORT AND ORDER

Adopted: April 21, 2016

Released: April 25, 2016

By the Commission: Commissioner O’Rielly approving in part, concurring in part and issuing a statement.

TABLE OF CONTENTS

Heading	Paragraph #
I. INTRODUCTION	1
II. BACKGROUND.....	5
A. Audio Low Pass Filtering Requirements	5
B. Terrestrial Trunked Radio (TETRA)	11
III. DISCUSSION	17
A. Digital Emission Mask Requirements	17
1. Emission Mask H	18
2. Data Throughput and Occupied Bandwidth.....	31
3. Regional Planning Committees.....	37
4. Adjacent Channel Power Limits.....	46
5. Prior Equipment Authorization	52
B. Analog FM Capability	56
1. Common Modulation	56
2. Base, Mobile and Portable Stations.....	60
C. Cost/Benefit Analysis	66
D. Equipment Certification and License Application Freeze	70
IV. PROCEDURAL MATTERS.....	72
A. Regulatory Flexibility Analysis	72
B. Paperwork Reduction Act Analysis	73
C. Congressional Review Act.....	74
V. ORDERING CLAUSES.....	75
APPENDIX A – Final Rules	
APPENDIX B – Final Regulatory Flexibility Act Analysis	
APPENDIX C – List of Commenting Parties	

I. INTRODUCTION

1. In this *Report and Order*, we adopt rules that guard against interference to critical public safety communications in the 800 MHz National Public Safety Planning Advisory Committee (NPSPAC)

band¹ (806-809/851-854 MHz) by confirming the emission mask applicable to digital transmissions in the NPSPAC band. We also take steps to enhance public safety system interoperability in the VHF, UHF and 800 MHz bands by specifying analog FM as the standard emission for use on all interoperability channels in these bands. In so doing we lessen the possibility that first responders will encounter harmful interference in the NPSPAC band and provide certainty to manufacturers concerning the capabilities required of radios used for interoperable communications.

2. In response to a Petition for Rule Making filed by the Harris Corporation (Harris), the Commission adopted a *Notice of Proposed Rulemaking (NPRM)*² that sought comment on proposed rules requiring digital technologies to comply with Emission Mask H (H-Mask)³ when operating in the 800 MHz NPSPAC band.⁴ An emission mask is an important technical parameter that affects the efficient use of a frequency band by limiting emissions from one channel into adjacent channels.⁵ The mask provides technical specifications which limit the distribution of power of a radio transmitter as a function of frequency.⁶

3. The *NPRM* also proposed requiring mobile and portable public safety radio equipment “to have analog FM capability when operating on 800 MHz, VHF, and UHF public safety mutual aid and interoperability channels.”⁷ To maintain the *status quo* pending the outcome of the rulemaking, the Commission’s Public Safety and Homeland Security Bureau (PSHSB) and Office of Engineering and Technology (OET) issued a joint public notice imposing a freeze on license applications and equipment certifications for digital equipment that did not comply with Emission Mask H in the NPSPAC band and public safety radio equipment that lacked analog FM capability on the VHF, UHF or 800 MHz interoperability and mutual aid channels.⁸

4. We conclude that the public interest will best be served by adopting the rules proposed in the *NPRM*, with certain changes that will reduce regulatory burdens on public safety entities and manufacturers. The rule changes adopted in this *Report and Order* provide certainty to public safety entities, Regional Planning Committees (RPCs),⁹ equipment manufacturers and equipment testing

¹ We refer to this band as the NPSPAC band because it was established by the Commission pursuant to recommendations from the National Public Safety Planning Advisory Committee. *See Development and Implementation of a Public Safety National Plan and Amendment of Part 90 to Establish Service Rules and Technical Standards for Use of the 821–824/866–869 MHz Bands by the Public Safety Services*, Gen. Docket 87-112, Report and Order, 3 FCC Rcd 905 (1987) (*NPSPAC Report and Order*).

² *Emission Mask Requirements for Digital Technologies on 800 MHz NPSPAC Channels; Analog FM Capability on Mutual Aid and Interoperability Channels*, Notice of Proposed Rulemaking, 28 FCC Rcd 13403 (2013) (*NPRM*).

³ *See* 47 C.F.R. § 90.210(h).

⁴ *NPRM*, 28 FCC Rcd at 13407 para. 10. Under this proposal Emission Mask B would continue to apply to analog FM equipment employing audio low-pass filters. *Id.* at 13407 n.31. *See* 47 C.F.R. § 90.210(b).

⁵ *See 1998 Biennial Regulatory Review - 47 C.F.R. Part 90 - Private Land Mobile Radio Services*, Report and Order and Further Notice of Proposed Rule Making, 15 FCC Rcd 16673, 16689 para. 33 (2000).

⁶ *See Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Agency Communication Requirements Through the Year 2010*, First Report and Order and Third Notice of Proposed Rulemaking, 14 FCC Rcd 152, 213 n. 337 (1998) (*700 MHz First Report and Order*).

⁷ *NPRM*, 28 FCC Rcd at 13410 para. 19.

⁸ *Id.* at 13410 para. 20. *Public Safety and Homeland Security Bureau and Office of Engineering and Technology Freeze Certain Applications in the 800 MHz NPSPAC Public Safety Band*, Public Notice, 28 FCC Rcd 12661 (PSHSB and OET 2013) (*Equipment Authorization Freeze Public Notice*).

⁹ In General Docket No. 87-112, the Commission, in response to Congressional directive, adopted a national framework, including service and technical rules, governing the use of the NPSPAC spectrum. As part of that framework, the Commission established 55 RPCs to develop regional plans tailored to regional public safety needs. The RPC plans set forth the guidelines to be followed in allotting spectrum to meet current and future mobile

(continued....)

laboratories and will ensure that licensed facilities operate under uniform technical parameters to maintain the existing interference environment in the NPSPAC band and promote interoperability.

II. BACKGROUND

A. Audio Low Pass Filtering Requirements

5. In 1977, the Commission sought to resolve a technical problem raised when high speed digital data was attempted to be transmitted by transmitters that had low-pass audio filters in their input stages.¹⁰ The Commission's then existing rules required that each transmitter in the Private Land Mobile Radio (PLMR) services be equipped with a low pass audio filter to insure that widely varying speech waveforms would not result in the production of excessive sideband emissions.¹¹ The Commission noted that lower bit rate digital signals could be passed through this filter without significant distortion.¹² With high bit rate digital signals, however, the Commission recognized that digital system performance depended on bypassing the audio low pass filter.¹³ The Commission observed that applying an audio low pass filter to high bit rate digital signals would significantly distort the digital signal. Therefore, the Commission sought to delete the audio low pass filter requirement for digital signals in order to facilitate digital operations in the PLMR bands, which had previously been authorized only for analog communications.¹⁴ The Commission proposed relying on the then existing emission mask limitation standards and measurement procedures to determine compliance with those requirements.¹⁵

6. In developing new emission mask standards for all digital emissions the Commission sought to provide adjacent channel interference protection comparable to that provided by analog transmitters equipped with an audio low pass filter.¹⁶ Essentially, the Commission deleted the audio low

(Continued from previous page) _____

communications requirements of the public safety entities operating in a particular region. RPC plans and plan amendments are subject to Commission review and approval. Upon Commission approval of an RPC plan, licensing of NPSPAC spectrum may commence immediately. *See NPSPAC Report and Order*, 3 FCC Rcd 905; *Development and Implementation of a Public Safety National Plan and Amendment of Part 90 to Establish Service Rules and Technical Standards for Use of the 821–824/866–869 MHz Bands by the Public Safety Services*, Gen. Docket 87-112, Memorandum Opinion and Order, 3 FCC Rcd 2113 (1988); Memorandum Opinion and Order on Reconsideration, 3 FCC Rcd 5391 (1988).

¹⁰ *See Amendment of Parts 89, 91, 93 and 95 (General Mobile Radio Service) of the Commission's Rules and Regulations to Provide for the use of F3Y Emission (digital voice modulation) in Secure Communications Systems and to Eliminate the Low Pass Audio Filtering Requirements in Digital Voice, Automatic Vehicle Monitoring (AVM) and Other High Bit Rate Digital Applications*, Docket No. 21142, Notice of Proposed Rulemaking, 63 FCC 2d 579, 581 para. 8 (1977) (*Digital Voice Modulation NPRM*).

¹¹ *Id.* at 582 para. 9. “The principal functions of the [audio low pass] filter are to remove distortion products produced by the modulation limiter, to attenuate the audio components above the cutoff frequency, and to attenuate noise components occurring in the audio stages of the transmitter. Thus, the filter serves to reduce unwanted sideband energy and thereby to reduce emissions capable of causing interference to adjacent channel stations.” *See Amendment of Parts 2, 6, 10, 11, and 16 of the Commission's Rules to Reduce Separation Between Assignable Frequencies in the 25-50 Mc and 152-162 Mc Bands; Amendment of Parts 2, 6, 7, 8, 10, 11 and 16 of the Commission's Rules to Reflect Conditions Concerning International Interference in the Band 25-50 Mc; Amendment of Parts 6, 10, 11, and 16 of the Commission's Rules to Provide for the Establishment of Narrow Band Technical Standards*, Docket 11523, Report and Order, 39 FCC 487 para. 4 (1956) (reducing the separation between assignable frequencies in the 152-162 Mc band).

¹² *Digital Voice Modulation NPRM*, 63 FCC 2d at 582 para. 9.

¹³ *Id.* at 582 paras. 9-11.

¹⁴ *Id.*

¹⁵ *Id.* at 582 para. 10.

¹⁶ *See Amendment of Parts 89, 91, 93 and 95 (General Mobile Radio Service) of the Commission's Rules and Regulations to Provide for the use of F3Y Emission (digital voice modulation) in Secure Communications Systems* (continued....)

pass filter requirement for all digital transmitters and substituted a modified version of the emission limitations then present in the rules.¹⁷ Thus, the Commission required that a showing be made, during the transmitter type acceptance process that the radiated emission of any digital transmitter complies with the applicable emission limitation, *i.e.*, the formula for attenuating the power of the emission as a function of frequency. In order to establish some flexibility in the rules, the Commission also authorized the optional removal of the low pass filter from analog transmitters provided that such transmitters complied with the new emission limitation standards specified for digital transmitters in the VHF, UHF and 800 MHz PLMR bands.¹⁸

7. In 1987, the Commission established an offset band plan for the NPSPAC band (25 kilohertz bandwidth channels evenly spaced every 12.5 kilohertz).¹⁹ In order to make efficient use of the offset channel plan, the Commission adopted certain technical parameters recommended in the NPSPAC Final Report for equipment to be used in the NPSPAC band, *e.g.*, 4 kilohertz deviation, as well as emission mask limitations for digital transmitters.²⁰ Thus, for the NPSPAC band, which was exclusively allocated for public safety and subject to regional planning and interoperability requirements, the Commission adopted what is now referred to as Emission Mask H in order to reduce adjacent channel interference in the offset NPSPAC environment, resulting in closer allowable geographically adjacent-channel assignments and improved spectrum utilization.²¹

8. The Commission's emission mask rules for digital equipment in the PLMR bands remained relatively undisturbed until the 1995 *Refarming First Report and Order*.²² In the *Refarming First Report and Order*, which focused on improving spectrum efficiency in the PLMR bands below 512 MHz, the Commission established narrowband channel bandwidths in both the 150–174 MHz VHF and 421–512 MHz UHF bands. The Commission established interstitial narrowband 12.5 kilohertz and 6.25 kilohertz bandwidth channels between the existing 25 kilohertz bandwidth channels²³ and adopted emission masks designed specifically for 12.5 kilohertz and 6.25 kilohertz bandwidth channels applicable to both VHF and UHF equipment and applicable to both analog and digital modulation regardless of whether the equipment implemented an audio low pass filter.²⁴ As part of the revised Part 90 rules, the Commission codified the distinction between analog transmitters equipped with an audio low pass filter and digital transmitters not equipped with audio low pass filters for purposes of determining which

(Continued from previous page) —————
and to Eliminate the Low Pass Audio Filtering Requirements in Digital Voice, Automatic Vehicle Monitoring (AVM) and Other High Bit Rate Digital Applications, Docket No. 21142, First Report and Order, 42 RR2d 355, 357-59 paras. 8-13 (1978) (*First Digital Voice Modulation Order*). Amendment of Parts 89, 91, 93 and 95 (General Mobile Radio Service) of the Commission's Rules and Regulations to Provide for the use of F3Y Emission (digital voice modulation) in Secure Communications Systems and to Eliminate the Low Pass Audio Filtering Requirements in Digital Voice, Automatic Vehicle Monitoring (AVM) and Other High Bit Rate Digital Applications, Docket No. 21142, Second Report and Order, 46 RR2d 937, 942 para. 16 (1979) (*Second Digital Voice Modulation Order*).

¹⁷ *First Digital Voice Modulation Order*, 42 RR2d at 359 para. 13.

¹⁸ *Second Digital Voice Modulation Order*, 46 RR2d at 944 para. 24.

¹⁹ National Public Safety Planning Advisory Committee, Final Report to the Federal Communications Commission (dated Sept. 9, 1987).

²⁰ *Id.* at 18; *NPSPAC Report and Order*, 3 FCC Rcd at 910 para. 24.

²¹ *Id.* at Appendix C (adopting 47 C.F.R. § 90.209(i)).

²² 47 C.F.R. § 90.210(h). See *Replacement of Part 90 by Part 88 to Revise the Private Land Mobile Radio Services and Modify the Policies Governing Them and Examination of Exclusivity and Frequency Assignment Policies of the Private Land Mobile Services*, Report and Order and Further Notice of Proposed Rule Making, 10 FCC Rcd 10076, Appendix F (1995) (*Refarming First Report and Order*).

²³ *Id.* at 10118 para. 86.

²⁴ *Id.* at 10118 paras. 85-86. 47 C.F.R. § 90.210, footnote 2.

emission mask was to be used.²⁵ Thus, with respect to the NPSPAC band, the Commission established that Emission Mask B applied to analog transmitters equipped with audio low pass filters and Emission Mask H applied to digital transmitters or analog transmitters not equipped with audio low pass filters.

9. In the *Refarming Second Memorandum Opinion and Order*, however, the Commission removed the analog-digital distinction from its rules for all PLMR frequency bands “without discussion.”²⁶ The analog-digital distinction became largely irrelevant for narrowband channels in the PLMR bands below 512 MHz because the Commission adopted emission masks that apply to transmitters operating on 12.5 kilohertz and 6.25 kilohertz bandwidth channels regardless of analog or digital modulation, *i.e.*, modulation-independent Emission Masks D and E.²⁷

10. Yet, the Commission retained the audio low pass filter requirement in the rules.²⁸ The distinction remains particularly relevant to understanding the relationship between the audio low pass filtering and emission mask requirements for equipment designed to operate with a 25 kilohertz bandwidth channel in the offset 800 MHz NPSPAC band. Specifically, Section 90.210 of the rules currently provides that (a) in the 800 MHz NPSPAC band, compliance with Emission Mask B is adequate for transmitters equipped with an audio low pass filter because the audio filter ensures that the emission will not produce excessive sideband emissions and (b) that compliance with Emission Mask H is necessary for transmitters without an audio low pass filter, as illustrated in Figure 1 below.²⁹

²⁵ *Id.* at Appendix F (revising 47 C.F.R. §§ 90.210 and 90.211). See also *Replacement of Part 90 by Part 88 to Revise the Private Land Mobile Radio Services and Modify the Policies Governing Them and Examination of Exclusivity and Frequency Assignment Policies of the Private Land Mobile Services*, Memorandum Opinion and Order, 11 FCC Rcd 17676, Appendix D (1996) (revising 47 C.F.R. § 90.211).

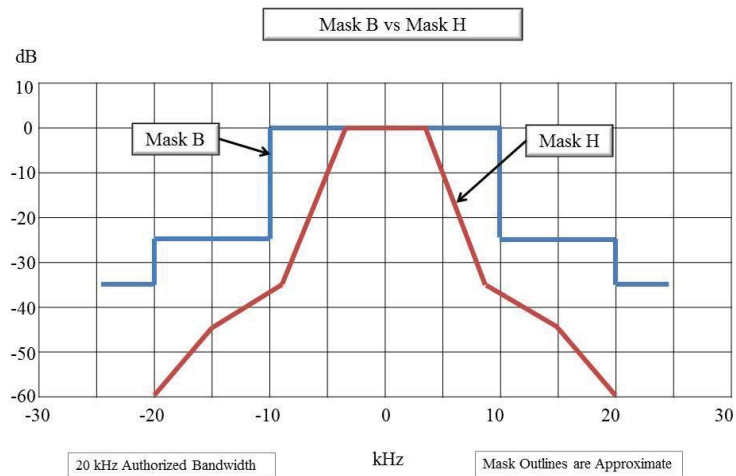
²⁶ See *Replacement of Part 90 by Part 88 to Revise the Private Land Mobile Radio Services and Modify the Policies Governing Them and Examination of Exclusivity and Frequency Assignment Policies of the Private Land Mobile Services*, Second Memorandum Opinion and Order, 14 FCC Rcd 8642, para. 3, Appendix C (1999) (removing former 47 C.F.R. § 90.211).

²⁷ See 47 C.F.R. § 90.210(d) and (e). See also *Biennial Regulatory Review -- Amendment of Parts 1, 22, 24, 27, and 90 to Streamline and Harmonize Various Rules Affecting Wireless Radio Services*, Report and Order and Further Notice of Proposed Rule Making, 20 FCC Rcd 13900, 13914 para. 27 (2005) (conforming Emission Mask G to modulation-independent Masks D, E, and F).

²⁸ See, *e.g.*, 1998 Biennial Regulatory Review – 47 CFR Part 90 – Private Land Mobile Radio Services, Memorandum Opinion and Order and Second Report and Order, 17 FCC Rcd 9830 (2002) (revising 47 C.F.R. § 90.210).

²⁹ 47 C.F.R. § 90.210(b).

FIGURE 1



B. Terrestrial Trunked Radio (TETRA)

11. In 2012, the Commission adopted the *TETRA Report and Order* in WT Docket No. 11-69,³⁰ which amended Part 90 of the Commission's rules to permit the certification and use of TETRA equipment in certain PLMR bands, provided it meets the Adjacent Channel Power (ACP) limits of Section 90.221 of the Commission's rules.³¹ Prior to the *TETRA Report and Order*, TETRA was not authorized for use in the United States because: (1) TETRA emissions exceed certain emission masks specified in Section 90.210 of the Commission's rules,³² and (2) TETRA uses a 22 kilohertz standard channel bandwidth that exceeds the 20 kilohertz maximum bandwidth for VHF, UHF and 800 MHz equipment specified in Section 90.209 of the Commission's rules.³³

12. In the *TETRA Report and Order*, the Commission amended Sections 90.210 and 90.209 to allow TETRA operations in the UHF band and the non-NPSPAC portion of the 800 MHz band, concluding that TETRA poses minimal risk of causing harmful interference in those band segments.³⁴ However, the Commission declined to allow TETRA operation in the 800 MHz NPSPAC band.³⁵ The Commission noted that, because the NPSPAC band has 25 kilohertz bandwidth channels that are spaced only 12.5 kilohertz apart, NPSPAC systems are more susceptible to adjacent channel interference than

³⁰ See *Amendment of Part 90 of the Commission's Rules to Permit Terrestrial Trunked Radio (TETRA) Technology*, Report and Order, 27 FCC Rcd 11569 (2012) (*TETRA Report and Order*). TETRA is a digital trunked radio technology that operates with Time Division Multiple Access (TDMA) in four time slots within a 25 kilohertz channel. *Amendment of Part 90 of the Commission's Rules to Permit Terrestrial Trunked Radio (TETRA) Technology*, Order on Reconsideration, 28 FCC Rcd 9639, 9640 para. 3 (2013) (*TETRA Clarification Order*). TETRA has been widely implemented in countries outside the United States, including for public safety communications. See *NPRM*, 28 FCC Rcd at 13404 para. 2.

³¹ 47 C.F.R. § 90.221.

³² *Id.* § 90.210.

³³ *Id.* § 90.209.

³⁴ *TETRA Report and Order*, 27 FCC Rcd at 11572 para. 5.

³⁵ *Id.* at 11573-74 para. 9.

systems in other bands that use 25 kilohertz spacing between 25 kilohertz bandwidth channels.³⁶ The Commission also noted that TETRA equipment is not interoperable with equipment commonly used in the NPSPAC band.³⁷

13. During the course of the TETRA rulemaking proceeding, some parties submitted filings disputing whether the Commission's existing rules allowed operation of so-called "low-power" TETRA equipment in the NPSPAC band.³⁸ Low-power" TETRA (also sometimes called reduced power TETRA) refers to technology that uses the TETRA waveform but operates at less than the 22 kilohertz bandwidth associated with the TETRA standard.³⁹ One wireless equipment manufacturer, PowerTrunk, Inc. (PowerTrunk), had developed a low-power TETRA technology that it contended should be permitted to operate in the NPSPAC band under existing rules. PowerTrunk noted that its technology uses the TETRA waveform but operates within a 20 kilohertz bandwidth, which complies with the maximum bandwidth allowed under Section 90.209 of the Commission's rules.⁴⁰ PowerTrunk also asserted that its technology complied with one of the two emission mask limits applicable to the NPSPAC band. Specifically, PowerTrunk contended that, while its technology did not comply with Emission Mask H, the stricter of the two emission masks, it did comply with Emission Mask B, the more relaxed emission mask applicable to NPSPAC band transmitters equipped with audio low-pass filters.⁴¹ PowerTrunk asserted that its equipment incorporated the equivalent of a low-pass audio filter, and, therefore, that compliance with Emission Mask B was sufficient to allow operation in the NPSPAC band.⁴²

14. In its 2012 Petition for Rulemaking and related *ex parte* filings, Harris disputes PowerTrunk's assertion that its low-power TETRA technology should be allowed to operate in the NPSPAC band. Harris asserts that PowerTrunk's technology would cause interference if used in the NPSPAC band unless it conformed to the more stringent Emission Mask H, and that PowerTrunk's claim of compliance with Emission Mask B is an attempt to take advantage of a "loophole" in the Commission's rules.⁴³ Harris also asserts that PowerTrunk's equipment would not support interoperable communications because it lacks analog FM capability, which is widely used to support interoperability in the VHF, UHF and 800 MHz public safety bands.

³⁶ *Id.*

³⁷ *Id.* at 11573 paras. 8-9. The Commission also declined to permit TETRA on the narrowband portion of the 700 MHz public safety band, noting that TETRA does not conform to the interoperability standard for the 700 MHz narrowband public safety band interoperability channels. *Id.* at 11574 para. 10.

³⁸ *Id.* at 11575 para. 13. *See, e.g.,* Letter from Patrick Sullivan, Harris Corp. to Marlene H. Dortch, Secretary, FCC, WT Docket 11-69 et al., (March 16, 2012) (Harris March 16 *Ex Parte*); Letter from Jose Martin, Executive Vice President, PowerTrunk, Inc., to Marlene H. Dortch, Secretary, FCC, WT Docket 11-69 et al., (March 23, 2012) (PowerTrunk March 23 *Ex Parte*).

³⁹ The terms "low-power" and "reduced-power" TETRA are not strictly accurate descriptions of the TETRA-based technology developed by PowerTrunk and others, which uses narrower bandwidth but operates with transmitter power output comparable to standard TETRA systems. Letter from Kevin Krufky, Alcatel-Lucent Corp. to Marlene Dortch, Secretary, FCC, WT Docket 11-69 et al., (March 23, 2012); PowerTrunk March 23 *Ex Parte*. Nevertheless, because the term "low-power TETRA" is in common usage, we use it herein to refer to modified TETRA technology, such as PowerTrunk's, that operates at 20 kilohertz bandwidth, which technology PowerTrunk more recently has identified as TETRA Interoperable Digital Land Mobile Radio (TI D-LMR). *NPRM*, 28 FCC Rcd at 14806 n. 13.

⁴⁰ PowerTrunk March 23 *Ex Parte* at 6.

⁴¹ *Id.* at 5-6.

⁴² *Id.* at 6.

⁴³ Petition for Rulemaking of Harris Corporation, filed April 30, 2012 at 1 (Harris Petition).

15. Because the issue of whether to permit reduced power TETRA was outside the scope of the TETRA proceeding, the Commission took no action with respect to reduced power TETRA or the Harris petition, but decided to address those matters in this proceeding.⁴⁴ The Commission noted that it was prepared to take “appropriate action if the record indicates an interference risk to public safety that needs to be addressed.”⁴⁵

16. In May 2012, the Commission issued a *Public Notice* seeking comment on the Harris Petition.⁴⁶ In response to comments filed, the Commission released the *NPRM*, noting that the Harris Petition “raises legitimate issues about maintaining a viable interference environment in the NPSPAC band and ensuring interoperability on the mutual aid and interoperability channels.”⁴⁷ Eight parties filed comments⁴⁸ in response to the *NPRM* and four parties filed reply comments.⁴⁹ In comments, PowerTrunk noted that it had modified its equipment authorization to add analog FM capability for mutual aid purposes before the release of the *NPRM*.⁵⁰ PowerTrunk’s “[c]ertification [, however, was] approved pursuant to the *Report and Order*, FCC 12-114 [i.e., the *TETRA Report and Order*].”⁵¹

III. DISCUSSION

A. Digital Emission Mask Requirements

17. At issue is which emission mask, if any, should be applied to equipment using digital emissions operating in the NPSPAC band. The options include (1) requiring all equipment using digital emissions operating in the NPSPAC band to conform to Emission Mask H, as proposed in the *NPRM*; (2) relying on Emission Mask B, as proposed by PowerTrunk; (3) developing a new emission mask standard that takes into account data throughput and occupied bandwidth, as suggested by PowerTrunk; (4) relying on RPC discretion to manage adjacent channel interference, as proposed by PowerTrunk; or (5) using some other approach, such as relying on ACP limits, as noted in the *NPRM*. For the reasons discussed below, we retain the Emission Mask H requirement as proposed in the *NPRM*. Accordingly, we modify Section 90.210 to more explicitly provide that (1) Emission Mask B applies to analog-modulated transmitters equipped with an audio low pass filter and (2) Emission Mask H applies to digitally modulated transmitters and to analog-modulated transmitters lacking an audio low pass filter.

⁴⁴ *TETRA Report and Order*, 27 FCC Rcd at 11575 para. 13 and n.46.

⁴⁵ *Id.* at 11575 n.46.

⁴⁶ See *Public Notice*, Report No. 2952, RM-11663 (CGB rel. May 31, 2012). Alcatel-Lucent, Harris, PowerTrunk, Motorola Solutions, Inc. (MSI), Nielson Communications, Inc. (Nielson), and New Jersey Transit (NJ Transit) filed individual comments. Harris and the National Public Safety Telecommunications Council (NPSTC) filed individual reply comments.

⁴⁷ *NPRM*, 28 FCC Rcd at 13407 para. 10.

⁴⁸ The Association of Public Safety Communications Officials – International (APCO), Harris Corp. (Harris), Motorola Solutions, Inc. (MSI), New Jersey Transit, NPSTC, PowerTrunk, Regional Planning Committee 13 (Region 13), and the Telecommunications Industry Association (TIA) filed individual comments.

⁴⁹ APCO, Harris, PowerTrunk and Regional Planning Committee 8 (Region 8) filed reply comments.

⁵⁰ PowerTrunk Comments at Exhibit B: Grant of Equipment Authorization FCC IDWT7PHTTT500760B (granted Apr. 15, 2013).

⁵¹ *Id.*

1. Emission Mask H

a. Background

18. In the *NPRM*, the Commission proposed to require all digital technology operating in the NPSPAC band to conform to Emission Mask H.⁵² The Commission explained that Section 90.210 of the Commission's rules – which defines Emission Mask B for transmitters equipped with an audio low pass filter – was adopted in the analog FM era but that an audio low pass filter is irrelevant to limiting the output wave form of a digital transmitter.⁵³ With this in mind, the Commission proposed closing the purported loophole in the Commission's rules to align more closely with industry practice, *i.e.*, to apply Emission Mask B only to NPSPAC band analog transmitters employing a low pass audio filter, and to apply Emission Mask H to digitally modulated NPSPAC band transmitters and analog transmitters lacking a low pass audio filter.⁵⁴

19. Thus, the Commission sought comment on whether manufacturers of digital equipment should be able to take advantage of an emission mask rule intended to apply to analog FM systems but inapplicable to digital systems.⁵⁵ The Commission tentatively concluded that “requiring digital systems to comply with Emission Mask H would reduce the potential of those digital systems to cause adjacent-channel interference in the NPSPAC band.”⁵⁶ The Commission also sought comment on whether the root raised cosine digital filter, conventionally used in digital systems to limit intersymbol interference, also provides protection against adjacent channel interference equivalent to that provided by an audio low pass filter in an analog system.⁵⁷

20. PowerTrunk claims that the Commission intended Emission Mask B to apply to both digital and analog equipment, and cites the Commission's *Refarming First Report and Order* as authority.⁵⁸ Specifically, PowerTrunk states that the Commission “proposed emission masks in 1995 as a mechanism to limit power as a function of frequency, and thereby minimize adjacent channel interference; that is, at the time the emission masks were proposed for 800 MHz, both analog and digital equipment were contemplated.”⁵⁹ However, the majority of commenters take the contrary position, (a) asserting that manufacturers of digital equipment should not be able to take advantage of an emission mask rule intended to apply to analog FM systems that employ an audio low pass filter, and (b) that requiring digital systems to comply with Emission Mask H will reduce the potential of digital systems to cause adjacent-channel interference in the NPSPAC band.⁶⁰ These parties concur that the NPSPAC channels are more susceptible to adjacent channel interference due to the 12.5 kilohertz channel spacing relative to the rest of the 800 MHz band, in which channels are spaced 25 kilohertz apart.⁶¹

⁵² *NPRM*, 28 FCC Rcd at 13407 para. 10, Appendix A. Under this proposal Emission Mask B would continue to apply to analog FM equipment employing audio low-pass filters. *Id.* at 13407 n. 31.

⁵³ *Id.* at 13407 para. 10.

⁵⁴ *Id.* at 13407 para. 11.

⁵⁵ *Id.*

⁵⁶ *Id.*

⁵⁷ *Id.* at 13408 para. 13.

⁵⁸ PowerTrunk Reply Comments at 3, citing *Refarming First Report and Order*, 10 FCC Rcd 10117-18 paras. 81-90.

⁵⁹ PowerTrunk Reply Comments at 3.

⁶⁰ APCO Comments at 2; Harris Comments at 4-6; MSI Comments at 3-4; NPSTC Comments at 3; Region 13 Comments at 1; TIA Comments at 4.

⁶¹ APCO Comments at 2; Harris Comments at 5-6; MSI Comments at 4; NPSTC Comments at 3; TIA Comments at 4-5.

21. PowerTrunk concedes that its TI D-LMR equipment does not conform to Emission Mask H, but argues that the spectrum efficiency benefits of its equipment (*i.e.*, achieving higher data rates at lower cost) outweigh the increase in adjacent channel interference.⁶² APCO and NPSTC assert that the interference avoidance benefits to public safety associated with Emission Mask H compliance for digital equipment in the NPSPAC band outweigh the higher data rates and lower-cost benefits asserted by PowerTrunk.⁶³

22. In addition, PowerTrunk argues that its TI D-LMR output wave form exhibits the same characteristics that are achieved via an audio low pass filter with analog equipment, *i.e.*, maintaining a constant width waveform independent of the modulating frequency.⁶⁴ PowerTrunk argues further that those waveform characteristics justify the application of Mask B to TI D-LMR.⁶⁵

23. In an effort to (1) demonstrate the spectrum efficiency benefits of TI D-LMR and (2) demonstrate that no emission mask alone can completely cure adjacent channel interference unless it conformed to the TIA limit of ACPR > -50dB, PowerTrunk submits an analysis which compares the adjacent channel power ratio (ACPR)⁶⁶ of various transmitters operating in a 12.5 kilohertz channel spacing environment.⁶⁷ PowerTrunk compares the ACPR of (a) an analog FM transmitter using 5 kilohertz deviation, (b) an analog FM transmitter using 4 kilohertz deviation, (c) a Harris OpenSky transmitter (F4GFSK emission) and (d) a PowerTrunk TI D-LMR transmitter (20K0D7W emission).⁶⁸ Power Trunk's TI D-LMR has an ACPR of -8 dB relative to the total power in the main channel.⁶⁹ The other technologies, however, have a significantly lower ACPR ranging from -19 dB to -24 dB relative to the total power in the main channel.⁷⁰ PowerTrunk claims that all of these transmitters, including TI D-LMR, cause "interference" into adjacent channels because they do not conform to the TIA ACPR > -50dB limit.⁷¹ "In other words," PowerTrunk submits, "neither emission masks nor ACPR limits provide meaningful limits on interference in the NPSPAC band unless the Commission adopts the TIA limit of ACPR > -50dB to prevent any interference to occur in an adjacent channel."⁷²

b. Decision

24. We retain the applicability of Emission Mask H to digital systems operating in the NPSPAC band because it suits the offset NPSPAC spacing environment. As PowerTrunk points out, Emission Mask H does not completely eliminate the potential for adjacent channel interference.⁷³ However, coverage in the NPSPAC band is interference-limited, *i.e.*, a certain degree of interference is tolerated in order to improve frequency reuse. PowerTrunk, by its own admission, would significantly increase that potential for adjacent channel interference as a tradeoff for higher data rates and cheaper

⁶² PowerTrunk Comments at 2-3; Power Trunk Reply Comments at 3-11.

⁶³ APCO Comments at 3; NPSTC Comments at 4.

⁶⁴ Power Trunk Reply Comments at 5.

⁶⁵ *Id.*

⁶⁶ The adjacent channel power ratio (ACPR) is the ratio of the total power in the adjacent channel to the total power of the main channel.

⁶⁷ PowerTrunk Comments at Exhibit A.

⁶⁸ *Id.*

⁶⁹ *Id.*

⁷⁰ *Id.*

⁷¹ *Id.* at 2.

⁷² *Id.*

⁷³ *Id.* at 1.

equipment.⁷⁴ PowerTrunk's ACPR analysis illustrates that the spectrum efficiency benefits of TI D-LMR do not justify applying Emission Mask B to digital systems, instead of Mask H, given the significant disparity in ACPR between TI D-LMR transmitters and (1) analog FM transmitters equipped with audio low pass filters and (2) digital transmitters that comply with Emission Mask H. PowerTrunk concedes that its TI D-LMR transmitter emits significantly more energy into the adjacent channels compared to the analog FM and the OpenSky digital transmitters referenced in PowerTrunk's technical analysis.⁷⁵ Were PowerTrunk allowed to proceed as requested, the proliferation of its transmitters in the marketplace could upset the careful coverage *vs.* interference balance in the NPSPAC band. Although PowerTrunk users would realize higher data rates, they would do so at the expense of causing interference to their adjacent channel neighbors. By comparison, licensees using digital equipment that conforms to Emission Mask H leave the coverage *vs.* interference environment in the NPSPAC band undisturbed. PowerTrunk has not demonstrated persuasively that applying Emission Mask B to digital emissions would result in a balance of competing policy goals that is better than the balance achieved by the current rules.

25. Moreover, contrary to PowerTrunk's assertion, the Commission intended to apply Mask H, not Mask B, to digital transmitters in the NPSPAC band.⁷⁶ PowerTrunk's reliance on the *Refarming First Report and Order* is misplaced. First, the Commission established emission mask requirements to apply to digital equipment. Consistent with the Commission's approach for specifying emission limits for digital equipment and the NPSPAC Final Report, the Commission adopted Emission Mask H for digital transmitters designed to operate in the offset NPSPAC band. Second, the *Refarming First Report and Order*, which focused on PLMR spectrum below 512 MHz, simply redesignated, in current Section 90.210(h), the Emission Mask H requirements adopted in the 1987 *NPSPAC Report and Order* and codified in former Section 90.209(i).⁷⁷ In other words, current Section 90.210(h) retains the same formula for attenuating the power of adjacent channel emissions that former Section 90.209(i) applied to NPSPAC transmitters that were not equipped with an audio low pass filter.⁷⁸ Further, the *Refarming First Report and Order* codified in the rules that (1) Emission Mask H applied to digital and analog equipment not equipped with an audio low pass filter and (2) Emission Mask B applied to analog transmitters equipped with an audio low pass filter. Because the Commission retained the audio low pass filter requirement in the rules, the deletion of the analog-digital distinction from Part 90 was unremarkable except for the fact that it created an ambiguity in the technical rules that could be exploited by manufacturers. Indeed, if we were to endorse PowerTrunk's view, then PowerTrunk and other manufacturers would be encouraged to market high-powered digital equipment that could undermine the technical rules for the offset NPSPAC band by substantially increasing adjacent channel interference and limiting frequency reuse. Thus, we find it necessary to close the loophole in the technical rules for the NPSPAC band to align with Commission precedent and industry practice and to avoid any further unintended consequences that could undermine reliable public safety interoperable communications.

26. PowerTrunk's assertion that its equipment employs a filter equivalent to an audio low pass filter obfuscates the relationship between an audio low pass filter and an emission mask as interference management tools, and so does not persuade us to revisit the coverage *vs.* interference balance we discussed above. Essentially, PowerTrunk's claim of an equivalent filter is an attempt to bypass the emission mask rules to introduce an unusually broad digital waveform into the NPSPAC band. PowerTrunk's theory that digital emissions need conform only to Emission Mask B is inconsistent with

⁷⁴ *Id.* at 2-3; PowerTrunk Reply Comments at 3-11.

⁷⁵ PowerTrunk Comments at Exhibit A. A difference of 3 dB equates to double the power radiated into the adjacent channel.

⁷⁶ *See supra* para. 5.

⁷⁷ *See NPSPAC Report and Order*, 3 FCC Rcd at 918, Appendix C.

⁷⁸ *Id.* (adopting Emission Mask H under Section 90.209(i)); 47 C.F.R. § 90.209(i) (1988).

the underlying purpose of the emission mask rules that differentiate between analog FM emissions and digital waveforms in the 800 MHz NPSPAC band.

27. First, the level of adjacent channel protection provided under Emission Mask B is premised on audio low-pass filtering, which is incompatible with high-speed digital modulation such as that used in Power Trunk's equipment.⁷⁹ The Commission exempted digital transmitters from the audio low pass filter requirement and adopted emission masks custom-tailored for digital signals to ensure that the digital signal did not significantly increase interference to adjacent channel operations.⁸⁰ The Commission also allowed the "optional" removal of audio low pass filters from analog transmitters, provided they conformed to a more rigorous emission mask. Consistent with that approach, the Commission adopted Emission Mask H for digital transmitters and analog transmitters not equipped with an audio low pass filter in order to make efficient use of the offset NPSPAC band.

28. Second, as explained in the *NPRM*, analog and digital transmitters have very different waveform characteristics, and those differences affect the usefulness of an audio low-pass filter. On one hand, the width of the emission waveform of an analog FM transmitter is a direct function of the modulating frequency, *i.e.*, the higher the modulating frequency, the wider the spectral waveform, and the greater the potential for adjacent channel interference. The Commission noted that "[t]he audio low-pass filter in a land mobile FM transmitter limits the modulating frequency, typically to 3 kilohertz, thus ensuring that the output waveform conforms to the relevant emission mask."⁸¹ Put simply, the audio low pass filter confines the analog modulation capable of causing adjacent channel interference, without compromising the reasonable communications needs of the user. On the other hand, "[t]he same relationship between the modulating frequency and the width of the emission waveform does not exist in digital systems such as TETRA, *i.e.*, the width of the emission waveform remains constant and independent of the voice baseband modulating frequency."⁸² "Accordingly, [the Commission stated,] the presence – or absence – of an audio low-pass filter in such digital equipment does not affect the width of the output waveform."⁸³

29. Third, analog FM voice emissions from a transmitter using an audio low pass filter fall well below the Emission Mask B limits, whereas the waveform of the TI D-LMR signal approaches those limits more closely. As illustrated in Figure 2, PowerTrunk's TI D-LMR transmitter emits a broad and power dense waveform which extends to the shoulders of Emission Mask B and concentrates a higher amount of energy within Emission Mask B than a typical analog transmitter that employs an audio low pass filter.⁸⁴ Furthermore, the PowerTrunk waveform remains constant when the TI D-LMR transmitter is active, radiating a constant amount of energy into the adjacent channels.⁸⁵ This is in contrast to an analog transmitter that employs an audio low pass filter where the energy radiated into the adjacent

⁷⁹ *Digital Voice Modulation NPRM*, 63 FCC 2d at 582 paras. 9-11.

⁸⁰ *First Digital Voice Modulation Order*, 42 RR2d at 359 para. 13; *Second Digital Voice Modulation Order*, 46 RR2d at 942-43 para. 18.

⁸¹ *NPRM*, 28 FCC Rcd at 13407 para. 10. In the *NPRM*, the Commission noted that PowerTrunk claimed "that no matter how loud the user of a PowerTrunk radio speaks, neither the emission mask boundaries, nor the occupied bandwidth limits would be exceeded at any time. Thus, the PowerTrunk equipment qualifies as equipped with an audio low-pass filter." See *NPRM*, 28 FCC Rcd at 13407 n. 33, citing PowerTrunk March 23 *Ex Parte* at 6. The Commission observed that "PowerTrunk appears to misunderstand the effect of an audio low-pass filter which limits the frequency, not the amplitude (loudness), of the input audio signal." *Id.*

⁸² *NPRM*, 28 FCC Rcd at 13407 para. 10.

⁸³ *Id.*

⁸⁴ See TIMCO Engineering, Inc., Test Report *re* WT7PTRNKTBSR75800 (dated Aug. 5, 2009) (PowerTrunk Test Report) at 13.

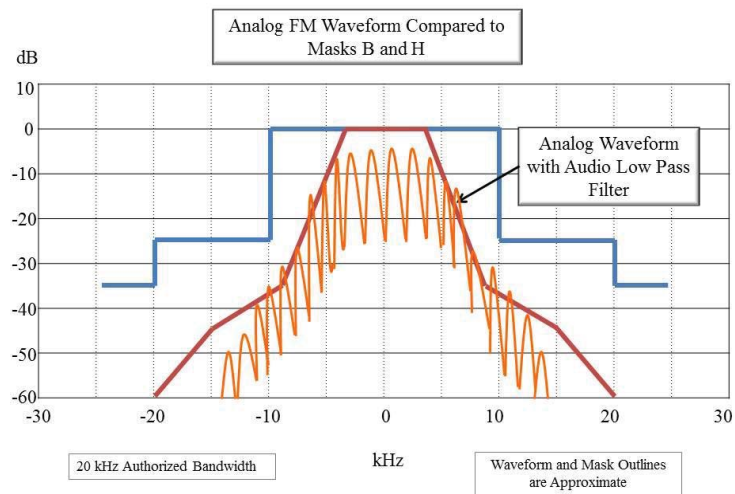
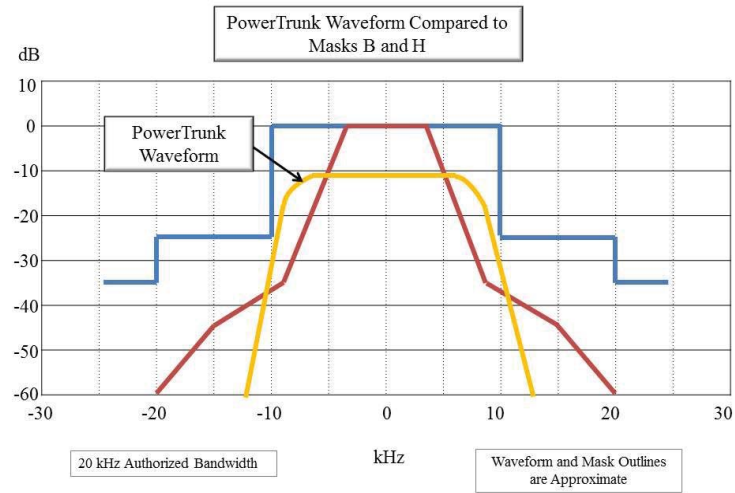
⁸⁵ PowerTrunk Reply Comments at 5.

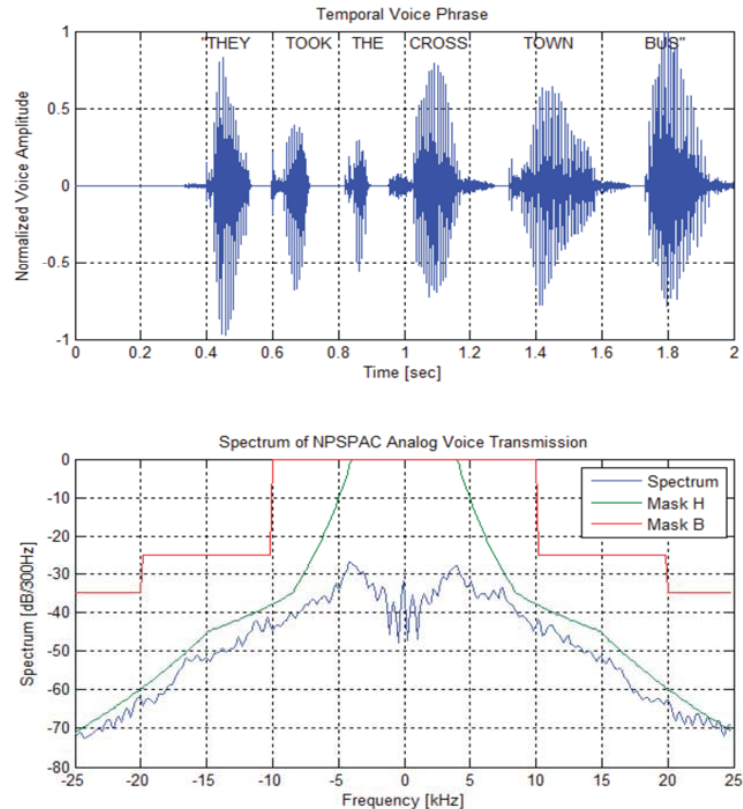
channel varies, is significantly less than the TI D-LMR waveform, and is a function of the modulating frequency.⁸⁶ As shown schematically in Figure 2, analog voice FM transmissions using an audio low pass filter as required by Emission Mask B remain substantially within the limits of Emission Mask H, but may exceed Emission Mask H during the “two-tone” test used in the equipment certification process.⁸⁷ Thus, a low-pass filtered analog signal that is required only to conform to Emission Mask B actually fits substantially into Emission Mask H under two-tone testing. Figure 3 demonstrates a more typical representation of a real world audio low pass filtered analog FM signal that remains entirely within the Emission Mask H limits. Given the disparity between PowerTrunk’s waveform and the waveform of equipment employing an audio low pass filter, it has no basis to claim that its filter “equivalent” provides interference protection comparable to analog FM equipment employing an audio low pass filter under Emission Mask B.

⁸⁶ *NPRM*, 28 FCC Rcd at 13407 para. 10.

⁸⁷ Harris argues that, in fact, analog FM voice transmissions using an audio low pass filter “adhere to the H Mask except in extreme, statistically insignificant cases.” Harris February 3 *Ex Parte* at 2. Harris points out that the spectral output of a transmitted analog FM voice waveform typically remains well within Emission Mask H, but can exceed Emission Mask H during the “two-tone test” typically performed during the equipment authorization process. *Id.*

FIGURE 2



FIGURE 3⁸⁸

30. We do not believe that emission mask requirements for digital emissions should be made less stringent to accommodate higher data rates because the cost – injecting significantly higher amounts of concentrated energy into NPSPAC band adjacent channels – is simply too high. Indeed, the record demonstrates that Emission Mask H has worked well in the NPSPAC band and that it is possible for digital systems – *e.g.*, Harris’ Open Sky system – to operate satisfactorily in the NPSPAC band while conforming to Emission Mask H.⁸⁹ Because of the NPSPAC band’s (1) unique channel spacing relative to the rest of the 800 MHz band, (2) reliance on regional planning for channel assignments, (3) interoperability requirements, (4) frequency reuse policies; and (5) likelihood that mission-critical public safety users, *e.g.*, police, fire and emergency medical service, within the same geographic area operate on adjacent channels, we conclude that relaxation of the NPSPAC emission mask rules is neither necessary nor practical. Furthermore, as discussed below, PowerTrunk and its supporters (1) fail to propose a workable alternative that would provide adjacent channel interference protection equivalent to Emission Mask H from high-powered digital emissions and (2) fail to demonstrate that the claimed data throughput benefits of TI D-LMR outweigh the costs to public safety.

⁸⁸ Exhibit from Harris *Ex Parte* February 3, 2014 at 3. An example of an analog modulated signal under the two-tone test is depicted *supra* Figure 2.

⁸⁹ APCO Comments at 3; Harris Comments at 5; MSI Comments at 3-4; NPSTC Comments at 4.

2. Data Throughput Versus Occupied Bandwidth

a. Background

31. In the *NPRM*, the Commission sought comment on an alternative to requiring conformance with Emission Mask H, in order to accommodate digital technologies with wider occupied bandwidths in the NPSPAC band.⁹⁰ In comments, PowerTrunk suggests that “should the Commission remain inclined to modify the Rule, it should consider inclusion of a new criterion, namely data throughput versus occupied bandwidth, especially for data-centric applications.”⁹¹ For example, according to PowerTrunk, its TI D-LMR offers a raw bit stream of 36 Kbit/s vs. the OpenSky system’s 19.2 Kbit/s, although as shown in PowerTrunk’s analysis, the OpenSky system provides ACPR > -20dB compared to TI D-LMR ACPR > -8dB (using a 4 kilohertz receiver filter at 12.5 kilohertz offset according to TSB-88.1-C).⁹² In this circumstance, PowerTrunk argues, “insistence on compliance with one mask versus another mask risks depriving public safety licensees of technology solutions which are more efficient from both a spectrum and financial standpoint. This would be unwise as a matter of public policy especially where there is an interference-avoidance mechanism in place in the form of the RPCs.”⁹³

32. As part of this discussion, PowerTrunk suggests that the size of exclusion zones should be considered as part of spectral efficiency.⁹⁴ In that connection, PowerTrunk notes that (1) the OpenSky system’s exclusion zone might be smaller than TI D-LMR in flat areas and (2) the TI D-LMR exclusion zone could be smaller than the exclusion zone of the OpenSky system if the former used directional antennas and the latter used omni-directional antennas.⁹⁵

33. Other commenters, however, submit that the spectrum efficiency benefits asserted by PowerTrunk for its equipment fail to overcome the consequent adjacent channel interference or conversely the need for increases in required geographic spacing between stations using low power TETRA and those using conventional technology.⁹⁶ Furthermore, Harris disputes PowerTrunk’s claim that its TI D-LMR transmitter is more spectrally efficient, noting that Harris’ 4-slot OpenSky system has a data rate of 1.58 bps/Hz compared with PowerTrunk’s 1.8 bps/Hz but also noting that its OpenSky system supports four voice calls in only 12.1 kilohertz of bandwidth whereas PowerTrunk’s TI D-LMR requires 20 kilohertz of bandwidth to support four voice calls.⁹⁷

b. Decision

34. We do not find PowerTrunk’s spectrum efficiency argument a sufficient reason to relax the emission mask requirements applicable to digital systems operating in the NPSPAC band. Low power TETRA systems are able to achieve higher data rates in the NPSPAC band only at the expense of increasing adjacent channel interference. This is a tradeoff that we are unwilling to make because it would upset the interference environment in the NPSPAC band, making fewer channels available for Public Safety licensees through spectrum reuse.

⁹⁰ *NPRM*, 28 FCC Rcd at 13408 para. 14.

⁹¹ Power Trunk Comments at 2.

⁹² *Id.* at 2 n. 4.

⁹³ *Id.* at 3.

⁹⁴ PowerTrunk Reply Comments at 11. PowerTrunk defines an exclusion zone as the geographical area where a given system’s radiation on the adjacent channels exceeds the TIA interference threshold. *Id.*

⁹⁵ *Id.* at 11-12.

⁹⁶ APCO Comments at 3; Harris Comments at 7-9; MSI Comments at 4-5; NPSTC Comments at 4.

⁹⁷ Harris Comments at 8-9.

35. In the *NPSPAC Report and Order*, the Commission recognized that a balance must be struck between occupied bandwidth, which affects data throughput, and adjacent channel interference caused to other nearby users, which affects frequency reuse. The Commission acknowledged that its 12.5 kilohertz offset channel plan required geographic separation of transmitters operating on adjacent channels.⁹⁸ However, it determined that the best balance was struck in favor of frequency reuse.⁹⁹ As part of that delicate calculation, the Commission adopted technical standards for transmitters, including Emission Mask H for digital transmitters and for analog transmitters that did not employ an audio low pass filter, because “these technical standards will reduce adjacent channel interference, permitting closer geographical channel re-use and thereby improving overall spectrum utilization.”¹⁰⁰ Additionally, the Commission directed all RPCs to explain in their regional plans how “the plan puts the spectrum to the best possible use by requiring system design with minimum coverage areas, by assigning frequencies so that maximum frequency reuse and offset channel use may be made[.]”¹⁰¹

36. Thus, we conclude that maintaining Emission Mask H is preferable to PowerTrunk’s proposal to introduce new data-throughput *vs.* occupied-bandwidth criteria to guide the RPCs in managing interference. We are not persuaded by PowerTrunk’s claim that its equipment’s asserted high data rate – offsets the potential for adjacent channel interference inherent in the equipment’s waveform. Although we agree with PowerTrunk that the interference environment in the NPSPAC band requires the coordination services provided by the RPCs, it is inescapable that PowerTrunk’s equipment – which conforms only to Emission Mask B – has a greater potential for adjacent channel interference than equipment that conforms to Emission Mask H and analog signals subject to audio low pass filtering. Therefore, to accommodate a low power TETRA system such as PowerTrunk’s, the RPCs would be required to increase geographic separation, thereby limiting the use of available spectrum in the NPSPAC band which already is congested in large metropolitan areas. Furthermore, we note that digital transmitters capable of complying with Mask H offer similar data rates on a per hertz basis and permit the same number of voice paths per channel as PowerTrunk’s TI D-LMR transmitter, while offering significantly higher levels of adjacent-channel protection and increased frequency reuse.¹⁰²

3. Regional Planning Committees

a. Background

37. In the *NPRM*, the Commission sought comment on a PowerTrunk suggestion that its TI D-LMR technology could be accommodated in the NPSPAC band if RPCs take the characteristics of PowerTrunk’s technology into account when coordinating and making channel assignments.¹⁰³ The Commission tentatively concluded that implementation of PowerTrunk’s proposal would impose an additional burden on RPCs and would necessarily restrict the ability of the RPCs to make efficient use of the NPSPAC spectrum.¹⁰⁴ The Commission sought comment on its view.¹⁰⁵

38. In comments, PowerTrunk argues that “neither Emission Mask B nor Emission Mask H are effective at eliminating interference in the NPSPAC frequencies due to the fact that 20 kilohertz

⁹⁸ *NPSPAC Report and Order*, 3 FCC Rcd at 908 para. 22.

⁹⁹ *Id.*

¹⁰⁰ *Id.* at 908 para. 24.

¹⁰¹ *Id.* at 911 para. 51.

¹⁰² Harris Comments at 8-9; Harris December 13 *Ex Parte* Statement.

¹⁰³ *NPRM*, 28 FCC Rcd at 13408 para. 12.

¹⁰⁴ *Id.*

¹⁰⁵ *Id.*

bandwidth NPSPAC channels are spaced only 12.5 kilohertz apart.”¹⁰⁶ PowerTrunk claims that, “[b]y implementing 12.5 kilohertz spacing, but allowing 20 kilohertz bandwidth equipment, the Commission has recognized that frequency coordination is required to minimize unacceptable interference.”¹⁰⁷ PowerTrunk states that RPCs “approve or reject specific radio system design on a case by case basis using strict criteria that account for the spectrum efficiency of the equipment and the topography of the specific region.”¹⁰⁸ PowerTrunk claims that “changing existing [Section] 90.210 [to expressly require conformance to Emission Mask H] would provide no meaningful benefit, but would encroach on the traditional role that RPCs have long fulfilled to manage acceptable interference.”¹⁰⁹

39. NJ Transit, a licensee that uses TETRA technology, “believes that the Commission should consider whether the coordination process, currently and successfully, followed by RPCs to support co-existing dissimilar technologies, is adequate, whatever the mix of technology is within the NPSPAC band *vs.* the rather narrow question of whether B-Mask or H-Mask should apply to digital equipment used in the NPSPAC spectrum.”¹¹⁰ Supporting the view that the current rules do not require digital equipment to conform to Emission Mask H, NJ Transit argues that “no additional rule changes are necessary to protect NPSPAC spectrum,” and that “[t]he current rules, as they are applied and interpreted for the application of B & H-masks, are sufficient to protect NPSPAC spectrum users from harmful interference when combined with the excellent coordination work done by the [RPCs].”¹¹¹

40. The Region 8 RPC concurs with NJ Transit.¹¹² Region 8 adds that its technical subcommittee can coordinate applications of varying R.F. bandwidths and that doing so does not create an additional burden.¹¹³ The Region 8 RPC also submits that “[a]ny extra burden would be on the licensee who would have to adhere to, perhaps, stricter spacing requirements, lower power, directional antenna patterns, etc. – all normal issues when coordinating dissimilar technologies.”¹¹⁴ According to the Region 8 RPC, the Commission should refrain from imposing “any mandatory emissions masks in the NPSPAC spectrum.”¹¹⁵ The Region 8 RPC believes coordination and assignment of spectrum should be left to the discretion of the RPC.¹¹⁶

41. Some commenters, however, contend that allowing low power TETRA in the NPSPAC band would impose an additional burden on RPCs and would necessarily restrict the ability of the RPCs to make efficient use of the NPSPAC spectrum.¹¹⁷ Thus, they submit that allowing low power TETRA in the NPSPAC band would limit RPC’s ability to reuse frequencies because it would require greater geographic spacing between stations, *i.e.*, larger exclusion zones, to minimize adjacent channel interference.¹¹⁸ For instance, NPSTC argues that permitting digital transmitters to exceed Mask H while

¹⁰⁶ PowerTrunk Comments at 1.

¹⁰⁷ *Id.* at 1-2.

¹⁰⁸ *Id.* at 2.

¹⁰⁹ *Id.*

¹¹⁰ NJ Transit Comments at 4.

¹¹¹ *Id.* at 5.

¹¹² RPC 8 Reply Comments at 1.

¹¹³ *Id.*

¹¹⁴ *Id.*

¹¹⁵ *Id.*

¹¹⁶ *Id.* at 2.

¹¹⁷ APCO Comments at 2; Harris Comments at 3, 6-7; MSI Comments at 5; NPSTC Comments at 3; Region 13 Comments at 1.

¹¹⁸ APCO Comments at 2-3; Harris Comments at 6; MSI Comments at 4.

operating in the NPSPAC band could necessitate “significant changes” to regional plans and require “re-coordination of incumbent operations” thereby taxing public safety resources “which are already stretched thin.”¹¹⁹ MSI also notes that the introduction into the NPSPAC band of digital equipment exceeding Mask H could, at a minimum, require “greater geographical spacing between adjacent channel users to avoid interference” and, in the worst case, “require the complete revamping of a region’s radio communications plan.”¹²⁰

b. Decision

42. We decline to direct RPCs to take low power TETRA operations into account when coordinating in the 800 MHz NPSPAC band, as PowerTrunk proposes. Among other things, such a requirement would compel RPCs to adopt larger exclusion zones in order to accommodate transmitters offering higher data rates through wider occupied bandwidths. Furthermore, the record indicates that accommodating digital emissions under Mask B through adoption of larger exclusion zones would impose an additional burden on public safety incumbents and preclude licensing of future public safety applicants. Harris, for example, demonstrates that a digital transmitter with a waveform conforming only to Emission Mask B would introduce significant additional interference to an adjacent-channel licensee operating at a distance of 35-miles compared to a digital transmitter with a waveform conforming to Emission Mask H.¹²¹

43. Additionally, we disagree with PowerTrunk’s claim that accommodating its technology involves “normal issues when coordinating dissimilar technologies.”¹²² Accommodating low power TETRA in the NPSPAC band would be far from a “normal issue” for RPCs; it would have a disruptive effect on carefully drawn regional plans designed to maximize frequency reuse and would result in a diminished amount of spectrum for the RPCs to administer. Moreover, as discussed above, PowerTrunk has not shown that the benefits it claims would result from use of its system would compensate for this loss of useable spectrum.¹²³

44. To the extent that PowerTrunk, NJ Transit and Region 8 believe that reliance on the discretion of the RPCs is adequate to minimize interference concerns, we find their view exaggerates the discretion accorded the RPCs. In setting national guidelines for use of the spectrum while allowing regional public safety planning committees to develop regional plans tailored to their areas’ own particular communications needs, the Commission concluded that “certain technical concerns must be addressed at the national level[.]”¹²⁴ The Commission explained further that, to “ensure that the National Plan encourages the most efficient utilization of the available spectrum and fosters interoperability between users, it is necessary to establish minimal technical standards for the regional plans.”¹²⁵ The emission masks in the Commission’s rules exemplify such minimal technical standards.

45. In summary, we will retain our emission mask requirements – amending the rules to make it clear that digital equipment operating in the NPSPAC band must conform with Emission Mask H¹²⁶ – rather than jeopardize the RPC’s current success in achieving an optimal balance of efficient

¹¹⁹ NPSTC Comments at 4.

¹²⁰ MSI Comments at 4.

¹²¹ See Harris December 13 *Ex Parte* Statement.

¹²² PowerTrunk Reply Comments at 10.

¹²³ See Section III.A.2., *supra*.

¹²⁴ NPSPAC Report and Order, 3 FCC Rcd at 905 para. 4.

¹²⁵ *Id.* at 907 para. 14.

¹²⁶ We strongly recommend that parties seeking a waiver of this requirement based on claims that the device in question would present as little interference potential as devices that comply with Emission Mask H provide a technical showing. Measurements of interference potential should be made by a Commission-accredited laboratory.

(continued....)

spectrum use and minimal interference, by eliminating the guidance provided by the mask requirements. We continue to believe that the distinction between analog and digital emissions remains relevant and critically important to maintaining the continued viability of the NPSPAC band given the disparity in the energy levels transmitted into the adjacent-channels by low power TETRA transmitters compared to analog transmitters employing an audio low-pass filter or digital transmitters complying with Mask H. Further, the emission mask requirements are a fairly straightforward standard to apply. They assist licensees and applicants by providing certainty to the NPSPAC interference environment, and make it relatively easy for RPCs to set policy on adjacent-channel reuse as well as facilitate adjacent region coordination. To abdicate our responsibility to set national technical standards for the NPSPAC band and to defer to RPC discretion to develop regional interference rules on an *ad hoc* basis for public safety spectrum would undermine the Commission's interoperability and frequency reuse goals for the NPSPAC band, lead to inconsistent interpretations of our technical standards, and potentially increase costs for public safety users in designing systems to accommodate dissimilar technologies.

4. Adjacent Channel Power Limits

a. Background

46. As an alternative to requiring digital transmissions in the 800 MHz band to conform with Emission Mask H, the Commission sought comment on development of a new mask or a different standard altogether, such as ACP limits, in order to accommodate digital technologies with wider occupied bandwidths in the NPSPAC band.¹²⁷ As an example of such ACP limits, the Commission cited PowerTrunk's September 2012 *ex parte* letter referencing the Commission's rules that rely on ACP limits in the 700 MHz bands.¹²⁸ The 700 MHz public safety narrowband "ACP limits are designed to reduce unwanted emissions from base station transmitters operating in the 769-775 MHz band into adjacent channels and other parts of the spectrum, including emissions into the 799-805 MHz band in which 700 MHz narrowband mobile units transmit and base stations receive (paired receive band)."¹²⁹

47. Most commenters support retaining the current NPSPAC emission masks because – unlike the 700 MHz narrowband channels – NPSPAC band channels are more closely spaced (12.5 kilohertz), and thus more susceptible to adjacent-channel interference than channels in the interleaved¹³⁰ segment of the 800 MHz band where channels are spaced 25 kilohertz apart.¹³¹ For instance, APCO notes that conformity to Emission Mask H has permitted digital transmitters to operate in the NPSPAC band for over twenty years with "minimal impact on incumbent adjacent channel licensees" and argues that any new standard "would need to provide the same level of protection as the current Mask H."¹³² NPSTC and

(Continued from previous page) _____

See 47 C.F.R. § 2.948. The technical showing should demonstrate persuasively that the proposed deviation from Emission Mask H would provide no greater interference to adjacent channel (12.5 kilohertz spacing) signals than equivalent equipment that conforms to Emission Mask H. See 47 C.F.R. § 1.925(b)(3).

¹²⁷ *NPRM*, 28 FCC Rcd at 13408 para. 14.

¹²⁸ *Id.* at 13408 n. 42 citing Letter from William K. Keane, Esq. to Marlene H. Dortch, Secretary, FCC (Sept. 21, 2012).

¹²⁹ See *Proposed Amendments to the Service Rules Governing Public Safety Narrowband Operations in the 769-775/799-805 MHz Bands*, Seventh Report and Order and Notice of Proposed Rulemaking, 28 FCC Rcd 4783, 4788-89 para. 10 (2013) (*Seventh Report and Order*). The ACP limit for 700 MHz narrowband base station emissions into the paired receive band is - 100 dBc ("decibels relative to carrier"). This measurement must be made at the transmitter's output port, *i.e.*, without regard to whether the operator uses combiners and external filtering to further attenuate the signal. See 47 C.F.R. § 90.543(b).

¹³⁰ The interleaved segment of the 800 MHz band includes channels reserved for business/industrial, public safety and specialized mobile radio (SMR) category users. See 47 C.F.R. § 90.617.

¹³¹ TIA Comments at 5; APCO Comment at 3-4.

¹³² *Id.* at 3-4.

MSI oppose developing a new emission mask or a different standard altogether for low-power TETRA – such as an ACP standard – as an alternative to requiring conformance with Emission Mask H.¹³³

48. NJ Transit, however, suggests that “the Commission should consider doing away with the emission masks and standardizing on adjacent channel power metrics as was done in other portions of the 700 and 800 MHz band.”¹³⁴ PowerTrunk asserts that neither emission masks nor ACPR limits would provide meaningful limits on interference in the NPSPAC band, but maintains that the TIA limit of ACPR > -50dB would prevent any adjacent channel interference.¹³⁵

b. Decision

49. Compliance with Emission Mask H will provide a better solution to adjacent channel interference concerns than imposing ACP limits similar to those adopted for the 700 MHz narrowband and 800 MHz interleaved bands. As noted by commenters, Emission Mask H has worked well in the NPSPAC band since 1987. We also agree with commenters that observe that reliance on ACP limits in the NPSPAC band is likely to lead to an increase in adjacent channel interference, and find nothing in the record to suggest that such ACP limits in the NPSPAC band would result in any public interest benefit likely to outweigh the costs of that increased interference and decreased frequency reuse.

50. We find NJ Transit unpersuasive to the extent it argues that ACP limits are warranted in the NPSPAC band because such limits are used in the 700 MHz band and the interleaved channels in the 800 MHz band. With respect to the 800 MHz band, we find that the rules allowing TETRA systems to operate on the interleaved channels there do not provide a good model for the NPSPAC band with respect to ACP limits, given that such TETRA operations are permitted only on 25 kilohertz bandwidth channels that are separated by 25 kilohertz (if in compliance with certain ACP limits based on TETRA standards).¹³⁶ As the Commission noted in the *TETRA Report and Order*, and as some of the commenters here have observed, NPSPAC band channels are more closely spaced than channels in the interleaved segment of the band, and thus they are more susceptible to adjacent-channel interference. Nor does the 700 MHz band serve as a good model for the NPSPAC band with respect to ACP limits because, unlike the 700 MHz narrowband public safety segment, which was designed from the outset to facilitate full-scale digital communications,¹³⁷ the 800 MHz NPSPAC band must accommodate both analog FM voice communications and digital systems.¹³⁸ Furthermore, similar to the 800 MHz interleaved band, the 700 MHz narrowband channel plan does not permit overlapping 25 kilohertz channels.¹³⁹ Therefore, operations in the 700 MHz narrowband public safety segment are not as susceptible to adjacent channel interference as operations in the 800 MHz NPSPAC band.

¹³³ MSI Comments at 5; NPSTC Comments at 4.

¹³⁴ NJ Transit Comments at 5.

¹³⁵ PowerTrunk Comments at 2. According to PowerTrunk’s analysis, which is based on TSB-88.1.C., TIA-603-C, Section 3.2.14 specifies an ACPR > -50dB in order to avoid potential interference in adjacent channels on 12.5 kilohertz spaced channels below 512 MHz. *Id.* at Exhibit A. TIA-603-C refers to Land Mobile FM or PM Communications Equipment Measurement and Performance Standards established by the Telecommunications Industry Association.

¹³⁶ *TETRA Report and Order*, 27 FCC Rcd at 11574-75 para. 12.

¹³⁷ *700 MHz First Report and Order*, 14 FCC Rcd at 214 para. 138.

¹³⁸ Consequently, rather than setting emission masks for the various types of communications in the 700 MHz narrowband, the Commission adopted emission limits for the 700 MHz band based on Adjacent Channel Coupled Power, which are the basis of the current ACP limits. *Id.* An ACP emission limit is based upon the absolute and relative levels of coupled power as a function of frequency that ensures that the adjacent channel interference potential of transmitters at various bandwidths is consistent and predictable. *Seventh Report and Order*, 28 FCC Rcd at n. 21.

¹³⁹ 47 C.F.R. § 90.531(d)(1); *700 MHz First Report and Order*, 14 FCC Rcd at 176 para. 44.

51. We also find that PowerTrunk has not provided an adequate basis for adopting its proposed ACPR floor of -50 dB. Assuming for the sake of argument that an ACPR floor of -50 dB would prevent adjacent channel interference as PowerTrunk claims, PowerTrunk submits that application of the ACPR floor of -50 dB would preclude deployment of all of the technologies identified in its ACPR study, including TI D-LMR, which it claims is the most efficient in terms of throughput and occupied bandwidth.¹⁴⁰ In other words, if we are not persuaded by PowerTrunk's central argument that the higher data rates of TI D-LMR outweigh its costs, then PowerTrunk proposes that we tip the scale so heavily in favor of adjacent channel interference protection that we ultimately sacrifice analog FM and digital technologies that are well-suited to the interference environment in the NPSPAC band. Neither proposition represents a satisfactory tradeoff we are prepared to make given that the existing rules are better designed to balance competing policy goals (*e.g.*, adjacent channel interference protection and efficient spectrum reuse) in the unique NPSPAC band. Thus, we find that clarifying the rules is a better option than adopting an ACPR floor of -50 dB.

5. Prior Equipment Authorizations

a. Background

52. In the *NPRM*, the Commission requested comment on the proposition that prior certification of digital equipment that complies with Emission Mask B is not a bar to adoption of a rule applying Emission Mask H to all digital equipment in the NPSPAC band.¹⁴¹ As an example, the Commission cited the below-512 MHz narrowbanding mandate where 25 kilohertz bandwidth equipment was no longer permitted after January 1, 2013, notwithstanding that such equipment previously was certified.¹⁴²

53. PowerTrunk attempts to distinguish the narrowbanding mandate from the instant proceeding, claiming that “the narrowbanding mandate was years in the making and did not impose a freeze on previously authorized equipment prior to implementation of the rule change.”¹⁴³ MSI states “the potential interference risk to public safety users in this band merits the Commission applying the new requirement to all equipment, even if it means that equipment authorized under Mask B must have its certification updated before future deployments can be conducted.”¹⁴⁴

b. Decision

54. As a general proposition, we do not find the prior certification of digital equipment that complies with Emission Mask B to be a bar to our adoption of a rule applying Emission Mask H to all digital equipment in the NPSPAC band. As the Commission noted in the *NPRM*, it has on a number of occasions adopted a rule change that rendered certified equipment no longer permissible in certain bands.¹⁴⁵ There is nothing in the record that leads us to question application of this practice to the circumstances here.

¹⁴⁰ PowerTrunk Reply Comments at 12-13.

¹⁴¹ *NPRM*, 28 FCC Rcd at 13408 para. 13.

¹⁴² *Id.* n.39.

¹⁴³ PowerTrunk Comments at 3 n.6.

¹⁴⁴ MSI Comments at 5.

¹⁴⁵ For example, under the Commission's narrowbanding mandate for bands below 470 MHz, 25 kilohertz bandwidth equipment was no longer permitted after January 1, 2013, notwithstanding that such equipment previously was certified. 47 C.F.R. § 90.209(b); *see also Implementation of Sections 309(j) and 337 of the Communications Act of 1934 as Amended; Promotion of Spectrum Efficient Technologies on Certain Part 90 Frequencies*, Third Memorandum Opinion and Order and Third Further Notice of Proposed Rule Making and Order, 19 FCC Rcd 25045 (2004).

55. We also find that PowerTrunk's attempt to distinguish its case from the narrowbanding case cited in the *NPRM* is not relevant. After the release of the *TETRA Report and Order* and before the release of the *NPRM*, PowerTrunk updated its equipment certification to reflect analog FM capability. PowerTrunk's certification, however was "approved pursuant to the Report and Order FCC 12-114."¹⁴⁶ The *Report and Order* that the PowerTrunk certification references is the *TETRA Report and Order*, which specifically deferred to this proceeding the issue of the appropriate emission mask to apply to low power TETRA in the NPSPAC band.¹⁴⁷ In other words, PowerTrunk's equipment certification is conditioned on the outcome of this proceeding, in which we now modify the rules to require more explicitly that digital emissions comply with emission mask H in the NPSPAC band, as the Commission intended when it adopted the technical rules for the NPSPAC band. Accordingly, upon the effective date of the rules adopted in this *Report and Order*, Power Trunk equipment that does not conform to emission mask H may no longer be used in new or modified NPSPAC systems.

B. Analog FM Capability on Mutual Aid and Interoperability Channels

1. Common Modulation

a. Background

56. In the *NPRM*, the Commission sought comment on whether it should require all public safety radios operating on the 800 MHz, VHF, and UHF bands to use a common modulation for mutual aid and interoperability channels.¹⁴⁸ The Commission noted that, "[w]hen the current rules were adopted, analog FM was the predominant modulation used on public safety frequencies, and as a consequence, most if not all public safety radios intended for use on mutual aid and interoperability frequencies are capable of analog FM operation."¹⁴⁹ However, the Commission observed that "the rules do not expressly require use of a common modulation, creating the potential for vendors to develop non-interoperable equipment."¹⁵⁰ Because analog FM has long been the *de facto* standard for communication on interoperability and mutual aid channels, the Commission sought comment on whether it should specify analog FM as the standard modulation for these channels.¹⁵¹ The Commission also invited comment on the potential public safety benefits of such a requirement, the cost burden, if any, that manufacturers would face in complying with the requirement, and whether the requirement would increase public safety licensees' costs.¹⁵²

¹⁴⁶ PowerTrunk Comments at Exhibit B *re* WT7PTHTT500760B (granted Apr. 15, 2013).

¹⁴⁷ *TETRA Report and Order*, 27 FCC Rcd at 11575 para. 13.

¹⁴⁸ *NPRM*, 29 FCC Rcd at 13410 para. 19, Appendix A.

¹⁴⁹ *Id.* See, e.g., http://www.motorola.com/Business/US-EN/Business+Product+and+Services/Two-Way+Radios++Public+Safety/P25+Portable+Radios/XTS2500_US-EN (Motorola Model XTS2500 "operates on P-25 analog and digital systems."); www.pspc.harris.com/.../7717C%20OpenSky2%20700-800%20MHz%20Overview_tcm27-13457.pdf ("Additionally, the VIDA architecture of the OpenSky2 system offers the capability of seamless interoperability with other analog or P25 systems."); http://www.kenwoodusa.com/Communications/Land_Mobile_Radio/Public_Safety/TK-5910 ("Included Modes: Analog Conventional (25 & 12.5 kilohertz), P25 Conventional, & P25 Trunked"); <http://www.taitradio.com/products-and-services/technologies-products/p25/products/portables/TP9100> ("Fully interoperable, the TP9100 gives you the flexibility of working in digital, analog and auto-sensing dual mode").

¹⁵⁰ *NPRM*, 29 FCC Rcd at 13410 para. 19.

¹⁵¹ *Id.*

¹⁵² *Id.*

57. Most commenters concur that requiring analog FM capability is both necessary and feasible.¹⁵³ Harris, for example, believes that “the absence of an express requirement of the use of common modulation has allowed some to attempt to introduce subscriber technology incapable of analog FM on such designated mutual aid/interoperability channels.”¹⁵⁴ Harris further asserts that this loophole may allow manufacturers to take advantage of a gap in the Commission’s interoperability rules, and “avoid baseline capabilities that enable interoperability among LMR vendors.”¹⁵⁵ Harris suggests changing the language of Sections 90.203(i) and (j)(1) to “harmonize the requirements for subscriber unit operation on designated mutual aid/interoperability channels in the VHF, UHF and 800 MHz NPSPAC and the 700 MHz public safety bands,” and “minimize any potential negative financial impact to public safety licensees.”¹⁵⁶ Harris contends that the proposed revision will further interoperability among subscriber units, harmonize the requirements for mobile and portable transmitters in the VHF, UHF, 800 MHz NPSPAC and 700 MHz bands, and avoid inadvertent application of the rules to base stations.¹⁵⁷

58. NJ Transit argues that the existing rules are sufficient and require no clarification regarding NPSPAC band radio equipment and mutual aid channels.¹⁵⁸ NJ Transit maintains that there are means of interoperable communications other than mutual aid channels, and states that “there are channels available on all common public safety bands used by jurisdictions for interoperable communications according to local plans.”¹⁵⁹ NJ Transit submits that the proposed rule change would mandate “a common mode to be built into a radio” and suggests that this does not necessarily “promote interoperability at a local level.”¹⁶⁰ NJ Transit states that the proposed rule change may unnecessarily raise the cost of equipment for “agencies that have a requirement for public-safety grade equipment but are not first responders with interoperable communications requirements.”¹⁶¹ NJ Transit believes that “[f]orcing a common mode into each and every radio is unnecessary and burdensome for users and would only create more expensive multi-mode equipment to meet a local requirement that could be met with much less funding through the use of a simpler, more cost-effective second radio.”¹⁶² NJ Transit believes that “[t]he solution for participating in mutual aid systems should be left to local agencies and not through

¹⁵³ APCO Comments at 4; NPSTC Comments at 1, 5 (noting that analog FM was recommended as the interoperability mode of operation in the Final NPSPAC Report); Region 13 Comments at 1; TIA Comments at 4; MSI Comments at 7.

¹⁵⁴ Harris Comments at 10.

¹⁵⁵ *Id.*

¹⁵⁶ *Id.* Specifically, Harris recommends that the Commission: “1) Mandate that all mobile portable transmitters certified for operation in the 150-174 MHz, 450-470 MHz and 800 MHz NPSPAC channels be capable of tuning to operate on the designated mutual aid channels; and 2) Mandate that mobile and portable transmitter operations on the 800 MHz mutual aid channels designated in the § 90.617(a)(1) of the rules, and that operation on the nationwide public safety interoperability calling channels in the 150-174 MHz and 450-470 MHz bands be FM modulation.” *Id.* at 11.

¹⁵⁷ *Id.* at 12.

¹⁵⁸ NJ Transit Comments at 7.

¹⁵⁹ *Id.* at 6.

¹⁶⁰ *Id.*

¹⁶¹ *Id.* at 6-7.

¹⁶² *Id.* at 7.

mandating a solution to be built into each and every radio certificated for NPSPAC operation.”¹⁶³ On the other hand, a number of commenters maintain that analog FM capability is achievable at minimal cost.¹⁶⁴

59. PowerTrunk submits that it has shown its commitment to the applicable interoperability rules through its updated certification of its multi-mode equipment prior to the release of the *NPRM*.¹⁶⁵ PowerTrunk echoes NJ Transit’s view that “certain end-users may not require multi-mode subscriber units in practice because they implement interoperability through alternative means.”¹⁶⁶ Additionally, PowerTrunk states that Section 90.203(i) only requires mutual aid interoperability for equipment marketed for public safety operation.¹⁶⁷ Therefore, PowerTrunk claims that changing the rules to require analog FM “does not reflect real world considerations”¹⁶⁸ because multi-mode radios are not capable of providing simultaneous operations in more than one mode.¹⁶⁹ PowerTrunk further states that multi-mode units cannot accommodate the interoperability requirements of some users¹⁷⁰ thus adopting the proposed rules “will invariably force manufacturers to add functionality that is neither necessary nor cost-effective.”¹⁷¹

60. APCO and Harris suggest that we apply any analog FM mandate that we adopt to mobile and portable radios, but not base stations, operating on the VHF and UHF interoperability channels and the 800 MHz NPSPAC mutual aid channels.¹⁷² APCO “believes that it is unnecessary, and potentially harmful, to require fixed base station equipment to meet such a certification requirement.”¹⁷³ APCO submits that “[i]nteroperability can be achieved with equipment certification requiring analog FM for mobiles and portables alone.”¹⁷⁴ APCO states that “[r]equiring that all fixed base stations equipment also include analog FM capability could add unnecessary equipment costs for licensees, without any substantial benefit.”¹⁷⁵ For the VHF and UHF interoperability channels, APCO proposes that we require analog FM mode on the VHF and UHF interoperability channels under Section 90.203(j)(1), not just the VHF and UHF calling channels.¹⁷⁶ For the 800 MHz NPSPAC mutual aid channels, APCO suggests that

¹⁶³ *Id.* at 8. RPC 8 states that “[a]s with any application submitted through RPC8, the applicant needs to demonstrate how this [interoperability] capability is met to the satisfaction of the RPCs based on the local role the entity plays.” RPC 8 Reply Comments at 3.

¹⁶⁴ APCO Comments at 4; Harris Comments at 10; NPSTC Comments at 5; TIA Comments at 7.

¹⁶⁵ PowerTrunk Reply Comments at 14.

¹⁶⁶ *Id.*

¹⁶⁷ *Id.*

¹⁶⁸ *Id.*

¹⁶⁹ *Id.*

¹⁷⁰ *Id.*

¹⁷¹ *Id.*

¹⁷² APCO Reply Comments at 1; Harris Comments at 10-12.

¹⁷³ APCO Reply Comments at 1.

¹⁷⁴ *Id.*

¹⁷⁵ *Id.*

¹⁷⁶ *Id.* at 2. APCO proposes the following rule change: “(1) Applications for certification received on or after January 1, 2005, for mobile and portable transmitters designed to transmit voice on public safety frequencies in the 150-174 MHz band will be granted only if the mobile/portable equipment is capable of operating in the analog *FM mode* on the nationwide public safety *channels* in the 150-174 MHz band. (See §90.20(c), (d) of this part.) Applications for certification received on or after January 1, 2005, for mobile and portable transmitters designed to transmit voice on public safety frequencies in the 450-470 MHz band will be granted only if the mobile/portable equipment is capable of operating in the *analog FM mode* on the nationwide public safety interoperability *channels* in the 450-470 band. (See §90.20(c), (d) of this part.)” *Id.*

“proposed Section 90.203(i) should be limited to mobile and portable equipment.”¹⁷⁷ With regard to the 12.5 kilohertz analog FM voice emission designator, APCO proposes that “Section 90.20(d)(80) be amended to require the use of analog (11K2F3E) emission for operation on the VHF and UHF interoperability channels, and that Sections 90.617(a)(1) and 90.619(a)(5)(i) be amended to require the use of analog (11K2F3E) emissions for operations on the mutual aid channels.”¹⁷⁸

61. Additionally, Harris notes that “existing base stations used by first responders in 800 MHz NPSPAC channels may not have any analog FM capability.”¹⁷⁹ Harris adds that “[a]dopting the analog FM mandate as applicable to ‘equipment’ in the 800 MHz NPSPAC band may negate the compliance of many previously certified and utilized 800 MHz NPSPAC base stations. Imposing the analog FM requirement on base stations in the 800 MHz NPSPAC band is not ‘in the public interest.’”¹⁸⁰ Additionally, Harris states, “while a common technology is not mandated for inclusion as part of the certification process, nothing has precluded manufacturers from making such common technology in fixed stations available for those who want such a capability.”¹⁸¹ Harris submits that “[e]ach manufacturer can and should be allowed to determine individually how to respond to any market demands that go beyond the desire for direct unit-to-unit interoperability, and public safety should be able to choose whether or not to incur the additional costs associated with such technology only if deemed appropriate.”¹⁸²

b. Decision

62. As described in more detail below, we are satisfied that requiring all public safety radios (mobile and portable units) operating on the 800 MHz, VHF, and UHF bands to use a common analog FM modulation on mutual aid and interoperability channels will promote interoperability and will not affect equipment costs appreciably. As an initial matter, promoting interoperability among public safety licensees yields substantial benefits in terms of facilitating the work of first responders in emergency situations. The proposed revision will further interoperability among subscriber units, harmonize the requirements for mobile and portable transmitters in the VHF, UHF, and 800 MHz NPSPAC band and avoid unnecessary burdens.¹⁸³ With respect to costs, most commenters acknowledge that analog FM capability is achievable at minimal cost. Further, when the Commission established the NPSPAC band, it believed it sufficient to require only use of conventional analog technology on the five mutual aid channels in the NPSPAC band.¹⁸⁴ Similarly, when the Commission designated interoperability channels in the existing VHF and UHF public safety bands, those bands were heavily encumbered with analog-only systems, which represented a significant financial investment in analog technology.¹⁸⁵ Thus, we continue to believe that analog FM is already the *de facto* interoperability standard on the mutual aid and interoperability channels and will be so for some time. Therefore, in light of the embedded base of equipment, we find that the 800 MHz mutual aid and VHF and UHF interoperability channels would be

¹⁷⁷ *Id.*

¹⁷⁸ *Id. citing* 47 C.F.R. §§ 90.20(d)(80); 90.617(a)(1) and 90.619(a)(5)(i).

¹⁷⁹ Harris Comments at 12.

¹⁸⁰ *Id.*

¹⁸¹ Harris Reply Comments at 9.

¹⁸² *Id.*

¹⁸³ APCO Reply Comments at 2; Harris Comments at 12.

¹⁸⁴ *NPSPAC Report and Order*, 3 FCC Rcd at 909 para. 38; *Memorandum Opinion and Order and Order on Reconsideration*, 3 FCC Rcd at 5391 para. 3.

¹⁸⁵ *Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Agency Communications Requirements Through the Year 2010*, Third Memorandum Opinion and Order and Third Report and Order, 15 FCC Rcd 19844, 19882-84 paras. 85-88 (2000).

of little value unless all equipment had this analog FM capability. We conclude that it is in the public interest to adopt this analog FM capability requirement for the mutual aid and interoperability channels, in light of the great benefits¹⁸⁶ and minimal costs of the proposal.

63. We also adopt APCO's proposal to amend Sections 90.20(d)(80),¹⁸⁷ 90.617(a)(1)¹⁸⁸ and 90.619(a)(5)(i) of the rules to require mobile and portable units to operate with analog FM emission on all 800 MHz mutual aid channels and all VHF and UHF interoperability channels.¹⁸⁹ Bearing in mind that many communications on the interoperability channels are on an on-scene, unit-to-unit, basis, and given that the authorizations for some existing base stations include emission designators other than analog FM, we do not extend the analog FM requirement to base stations. Our decision moots the concerns of commenting parties about the expense and logistical difficulties of requiring base stations to have analog FM capability in addition to other chosen modulation technology.¹⁹⁰ We do, however, recommend, but do not require, that, at a minimum, base stations on the interoperability and mutual aid calling channels be operated with analog FM modulation.

64. With regard to NJ Transit's concerns that mandating a common analog FM modulation would raise equipment costs, we find the commenters arguing that the costs of such a requirement are minimal to be more persuasive.¹⁹¹ APCO states that "[a]nalog FM is already the *de facto* national interoperability standard in public safety bands with mixed analog and digital operations because of its widespread use and availability in both older and newer equipment from multiple vendors."¹⁹² NPSTC notes that "[t]he practice of the public safety community and industry continues to be to use analog FM as the interoperability mode for 800 MHz, VHF and UHF mutual aid and interoperability calling channels."¹⁹³ Thus, we believe that codifying this common practice essentially clarifies the requirement for public safety entities and industry and adds little if any burden on these parties.

65. Finally, in its comments, APCO raises a specific issue about the type of mutual aid or interoperability channel that should be covered by a common modulation requirement, indicating that a common modulation should be required on both the interoperability calling channels and the interoperability tactical channels.¹⁹⁴ We agree and observe that the interoperability calling channels and the interoperability tactical channels both were comprehended in the term "mutual aid and interoperability channels" used in the *NPRM*.

¹⁸⁶ The benefit is significant because the bar on new certifications of radios that do not include analog FM capability safeguards against the hazardous circumstance in which lack of a common modulation on interoperability or mutual aid channels causes a communications breakdown during an emergency incident, and because the current state of the market may not provide sufficient protection against this hazard in the event we were to issue a certification for radio that lacks this capability.

¹⁸⁷ 47 C.F.R. § 90.20(d)(80).

¹⁸⁸ 47 C.F.R. §§ 90.617(a)(1); 90.619(a)(6)(i).

¹⁸⁹ This requirement does not affect previously deployed mobile and portable units, if any that lack analog FM capability on the 800 MHz mutual aid channels and the UHF and VHF interoperability channels.

¹⁹⁰ See, e.g., Harris Comments at 12.

¹⁹¹ APCO Comments at 4; Harris Comments at 10; NPSTC Comments at 5; TIA Comments at 7.

¹⁹² APCO Comments at 4 (noting that "code and ANSI standards-setting organizations already require the use of analog FM modulation in certain public safety communications settings.").

¹⁹³ NPSTC Comments at 5 (noting that "[o]ther technologies developed with U.S. public safety requirements and operational environment in mind such as the Project 25 standard have incorporated backward compatibility with analog FM.").

¹⁹⁴ APCO Comments at 5 and n.4.

C. Cost/Benefit Analysis**a. Background**

66. In the *NPRM*, the Commission sought comments on the costs and benefits associated with requiring digital systems in the NPSPAC band to comply with Emission Mask H.¹⁹⁵ The Commission also sought comment on the potential public safety benefits of requiring analog FM capability, the cost burden, if any, that manufacturers would face in complying with the analog FM requirement, and whether the requirement would increase public safety licensees' costs.¹⁹⁶

67. Harris suggests it is "highly unlikely" that requiring digital transmitters to comply with Mask H will in any way "limit investment or otherwise slow innovation" for digitally modulated equipment.¹⁹⁷ PowerTrunk, however, suggests that the requirement would impede the use and development of low cost equipment, claiming that its TI D-LMR radios are cheaper than digital radios that conform to the H Mask.¹⁹⁸

b. Decision

68. Assuming, *arguendo*, that PowerTrunk's radios are cheaper and have a higher data rate than radios that conform to Emission Mask H, we observe that the higher data rate comes at the cost of adjacent channel interference. Thus, the benefit of the asserted higher data rates is achieved only because the PowerTrunk radios have interference products that fall outside Emission Mask H, with the attendant potential for creating interference to adjacent channel licensees. The cost consequences include the cost the interfered-with licensee incurs in overcoming the interference, e.g. higher power, the addition of sites, or trouble shooting harmful events. In particular, to combat that interference, adjacent channel licensees would have to increase base station power or antenna height, or install an additional "fill in" base station to provide service to the area affected by interference. Accordingly, the benefit of higher data rates from stations that do not conform to Emission Mask H would be borne, not by the non-compliant licensee, but by the adjacent channel licensee(s) affected by the resultant interference. Therefore, even assuming that a licensee perceived higher data rates – and cheaper radios -- as a benefit, we are not willing to shift the cost of achieving such a problematic benefit to the licensee's adjacent channel neighbors.

69. Similarly, we determined above that there is continued support to specify analog FM as the standard modulation for the interoperability channels, and that the resultant achievement of interoperability for all licensees operating in the NPSPAC band outweighs the relatively minimal costs of conforming to the requirement. Indeed, while PowerTrunk opposes the analog FM interoperability requirement, it has not, in its pleadings, quantified the costs of such a requirement. Moreover, following release of the *NPRM* ¹⁹⁹ PowerTrunk obtained certification of radios with analog FM capability – a further indication that the cost of doing so is not prohibitive.²⁰⁰ Accordingly, we have weighed the indefinite, but not prohibitive, cost of providing analog FM capability – and, therefore, interoperability -- to equipment capable of operating on the interoperability channels against the benefit that interoperability provides for first responders and concluded that the benefits outweigh the costs. Also, as noted *supra*, the recommendation – but not requirement -- that base stations operating on the interoperability and mutual aid channels use analog modulation will benefit interoperability without increasing the cost of those stations.

¹⁹⁵ *NPRM*, 28 FCC Rcd at 13409 para. 15.

¹⁹⁶ *Id.* at para. 19.

¹⁹⁷ Harris Comments at 13.

¹⁹⁸ PowerTrunk Reply Comments at 13.

¹⁹⁹ *NPRM*, 28 FCC Rcd at 13409.

²⁰⁰ PowerTrunk Comments at 3.

D. License Application and Equipment Certification Freeze

70. In light of our decisions in this *Report and Order*, the freeze²⁰¹ on license applications and certification of radios that do not provide FM analog capability on all interoperability and mutual aid channels shall remain in effect until the effective date of the rules in Appendix A. The freeze²⁰² on base stations and radios that do not meet Emission Mask H criteria in the NPSPAC band shall remain in effect until the effective date of the rules in Appendix A. These rule revisions will take effect 30 days after a summary of this *Report and Order* is published in the Federal Register. Once effective, the rules will provide public safety entities, RPCs, equipment manufacturers, and equipment certification laboratories certainty that (1) digital equipment must comply with Emission Mask H in the NPSPAC band and (2) all mobile and portable equipment marketed and licensed for operation on the mutual aid and interoperability channels must comply with the rules adopted in this *Report and Order*.

71. PowerTrunk notes that it had obtained an authorization for its radio equipment and argues that the freeze constitutes a change in Commission policy that was “inequitable,” imposing an “unexpected hardship” on PowerTrunk.²⁰³ We treat PowerTrunk’s argument as an application for review of the *Equipment Authorization Freeze Public Notice* and deny the application. First, the freeze did not affect PowerTrunk’s equipment authorization. The *Equipment Authorization Freeze Public Notice* declared that OET would no longer accept applications for authorization of certain equipment as of the date of the public notice, August 27, 2013, and therefore did not apply to PowerTrunk’s equipment authorizations. Second, as noted above, PowerTrunk’s equipment authorization was conditioned on the outcome of this rulemaking proceeding. Thus, PowerTrunk was on notice as of the date its conditional authorization was granted that it might be precluded from marketing its radios in the NPSPAC Band as a result of this proceeding. Accordingly, we disagree with PowerTrunk that any hardship that resulted from the freeze is inequitable or should have been unexpected by PowerTrunk.

IV. PROCEDURAL MATTERS**A. Regulatory Flexibility Analysis**

72. Pursuant to the Regulatory Flexibility Act of 1980,²⁰⁴ as amended, the Final Regulatory Flexibility Analysis in this *Report and Order* is attached as Appendix B.

B. Paperwork Reduction Act Analysis

73. This document does not contain new or modified information collection requirements subject to the Paperwork Reduction Act of 1995 (PRA), Public Law 104-13. In addition, therefore, it does not contain any new or modified information collection burden for small business concerns with fewer than 25 employees, pursuant to the Small Business Paperwork Relief Act of 2002, Public Law 107-198.²⁰⁵

C. Congressional Review Act

74. The Commission will send a copy of this Report and Order to Congress and the Government Accountability Office pursuant to the Congressional Review Act.²⁰⁶

²⁰¹ *Equipment Authorization Freeze Public Notice*, 28 FCC Rcd at 12661.

²⁰² *Id.*

²⁰³ PowerTrunk Comments at 3-4.

²⁰⁴ See 5 U.S.C. § 604.

²⁰⁵ See 44 U.S.C. § 3506(c)(4).

²⁰⁶ See 5 U.S.C. § 801(a)(1)(A).

V. ORDERING CLAUSES

75. Accordingly, IT IS ORDERED, pursuant to Sections 1, 2, 4(i), 4(j), 301, 302, 303, 308, 309(j), and 332 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 151, 152, 154(i), 154(j), 301, 302, 303, 308, 309(j), and 332, that this *Report and Order* is hereby ADOPTED. Part 90 of the Commission's rules, 47 C.F.R. Part 90, is revised as set forth in Appendix A to this *Report and Order*. These rule revisions will take effect 30 days after the date of publication of the text thereof in the Federal Register.

76. IT IS FURTHER ORDERED THAT the equipment authorization freeze announced in the *Public Notice*, 28 FCC Rcd 12661, SHALL BE TERMINATED on the date the rule revisions as set forth in Appendix A become effective.

77. IT IS FURTHER ORDERED that the Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, SHALL SEND a copy of this *Report and Order*, including the Final Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration.

78. IT IS FURTHER ORDERED that the Commission SHALL SEND a copy of this *Report and Order*, to Congress and the Government Accountability Office pursuant to the Congressional Review Act, *see* 5 U.S.C. 801(a)(1)(A).

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch
Secretary

APPENDIX A**Final Rules**

Chapter 1 of Title 47 of the Code of Federal Regulations is amended as follows:

Part 90 – Private Land Mobile Radio Services

1. The authority citation for Part 90 continues to read as follows:

AUTHORITY: Sections 4(i), 11, 303(g), 303(r), and 332(c)(7) of the Communications Act of 1934, as amended, 47 U.S.C. 154(i), 161, 303(g), 303(r), 332(c)(7).

2. Section 90.20 is revised by amending paragraph (d)(80) as follows:

(d) ***

(80) After December 7, 2000 this frequency is available primarily for public safety interoperability only communications. Stations licensed prior to December 7, 2000 may continue to use this frequency on a co-primary basis until January 1, 2005. After January 1, 2005, all operations will be secondary to co-channel interoperability communications. Analog FM emission shall exclusively be used for operation on the VHF and UHF interoperability channels.

3. Section 90.203 is revised by amending paragraphs (i) and (j)(1) as follows:

(i) Mobile/portable equipment capable of use in the 806-809/851-854 MHz band segment and submitted for certification thirty or more days after publication of a summary of the *Report and Order*, (FCC 16-48, released April 25, 2016) in PS Docket 13-209 in the Federal Register must have the capability to operate in the analog FM mode on the mutual aid channels designated in § 90.617(a)(1) of the rules.

(j) ***

(1) Applications for certification of mobile and portable equipment designed to transmit voice on public safety frequencies in the 150–174 MHz or 450–470 MHz band will be granted only if the mobile/portable equipment is capable of operating in the analog FM mode on the nationwide public safety interoperability channels in the 150–174 MHz band or 450–470 MHz band, as appropriate. (See § 90.20(c), (d)(80) of this part.)

4. Section 90.210 is revised by amending the Table to add footnote 6 to read as follows:

§ 90.210 Emission Masks.

Applicable Emission Masks

Frequency band (MHz)	Mask for equipment with audio low pass filter	Mask for equipment without audio low pass filter
***	***	***
806-809/851-854 ⁶	B	H
***	***	***

⁶Transmitters utilizing analog emissions that are equipped with an audio low-pass filter must meet Emission Mask B. All transmitters utilizing digital emissions and those transmitters using analog emissions without an audio low-pass filter must meet Emission Mask H.

5. Section 90.617 is revised by amending paragraph (a)(1) as follows:

(a) ***

(1) Channels numbers 1–230 are also available to eligible applicants in the Public Safety Category in non-border areas. The assignment of these channels will be done in accordance with the policies defined in the Report and Order in Gen. Docket No. 87–112 (See § 90.16). The following channels are available only for mutual aid purposes as defined in Gen. Docket No. 87–112: channels 1, 39, 77, 115, 153. Mobile and portable radios operating on the mutual aid channels shall employ analog FM emission.

6. Section 90.619 is revised by amending paragraphs (a)(5)(i) and (c)(6)(i) as follows:

(a) ***

(5) ***

(i) Channels numbers 1–230 are also available to eligible applicants in the Public Safety Category in non-border areas. The assignment of these channels will be done in accordance with the policies defined in the Report and Order in Gen. Docket No. 87–112 (See § 90.16). The following channels are available only for mutual aid purposes as defined in Gen. Docket No. 87–112: Channels 1, 39, 77, 115, 153. Mobile and portable radios operating on the mutual aid channels shall employ analog FM emission.

(c) ***

(6) ***

(i) Channel numbers 1–230 are also available to eligible applicants in the Public Safety Category in the Canada Border Regions. The assignment of these channels will be done in accordance with the policies defined in the Report and Order of Gen. Docket No. 87–112 (See § 90.16). The following channels are available only for mutual aid purposes as defined in Gen. Docket No. 87–112: Channels 1, 39, 77, 115, 153. Mobile and portable radios operating on the mutual aid channels shall employ analog FM emission.

APPENDIX B

Final Regulatory Flexibility Analysis

1. As required by the Regulatory Flexibility Act of 1980, as amended (RFA),¹ an Initial Regulatory Flexibility Analysis (IRFA) was incorporated in the *Notice of Proposed Rulemaking (NPRM)*.² The Commission sought written public comment on the proposals in the *NPRM*, including comment on the IRFA.³ The comments received are discussed below. This present Final Regulatory Flexibility Analysis (FRFA) conforms to the RFA.⁴

A. Need for, and Objectives of, the Proposed Rules

2. The basic purpose of the *Report and Order* is to amend the Part 90 technical rules in order to prevent adjacent channel interference and promote interoperable public safety communications. In the *Notice of Proposed Rulemaking* we proposed to adopt rules that guard against interference to critical public safety communications in the 800 MHz NPSPAC band and enhance public safety system interoperability in the VHF, UHF and 800 MHz bands. Most commenters submit that digital equipment should not be authorized in the NPSPAC band unless it complies with Emission Mask H because digital transmitters increase the potential for adjacent channel interference and reduce frequency reuse in the limited NPSPAC spectrum. Most commenters also believe that public safety radios should have analog FM capability when operating on the mutual aid and interoperability channels.

3. Based on the record, we conclude that the public interest will best be served by adopting the rules proposed in the *NPRM*, with certain changes that will reduce regulatory burdens on public safety entities and manufacturers. The rule changes adopted in this *Report and Order* provide certainty to public safety entities, regional planning committees (RPC), equipment manufacturers, and equipment certification laboratories, and will ensure that licensed facilities operate under uniform technical parameters to maintain the extant interference environment in the NPSPAC band and promote interoperability.

B. Summary of Significant Issues Raised by Public Comments in Response to the IRFA

4. There were no comments raised that specifically addressed the proposed rules and policies presented in the IRFA. Nonetheless, we considered the potential impact of the rules proposed in the IRFA on small entities and reduced the compliance burden for all small entities in order to reduce the economic impact of the rules enacted herein on such entities.

5. First, our decision to apply the H Mask to digital technology is limited to equipment that operates in the sensitive interference environment of the NPSPAC band where 25 kilohertz channels are spaced only 12.5 kilohertz apart. We recognize that the NPSPAC channels are more susceptible to adjacent channel interference due to the 12.5 kilohertz channel spacing relative to the rest of the 800 MHz band, which are spaced 25 kilohertz apart. Low power TETRA would increase adjacent channel interference potential, require greater geographic separation to mitigate interference and thus reduce spectrum reuse of limited public safety spectrum. Thus, by amending the emission mask rules applicable to the NPSPAC band, we reduce the economic burden on public safety licensees in having to contend with increased adjacent channel interference and decreased spectrum availability.

¹ See 5 U.S.C. § 603. The RFA, *see* 5 U.S.C. § 601 – 612, has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Pub. L. No. 104-121, Title II, 110 Stat. 857 (1996).

² See *NPRM*, 29 FCC Rcd at 13412 para. 29, 13416 Appendix B.

³ *Id.*

⁴ See 5 U.S.C. § 604.

6. Second, our decision to require analog FM common modulation capability promotes interoperability on the mutual aid channels and the VHF/UHF interoperability channels. In light of the embedded base of analog FM equipment on the mutual aid and VHF/UHF interoperability channels, we believe that requiring a common modulation scheme would be a low-cost measure to ensure that these channels remain available during times of crisis.

7. Third, the record shows that the benefits to public safety users of requiring (1) digital technologies to comply with Emission Mask H when operating in 800 megahertz band NPSPAC band and (2) to require equipment to have analog FM capability when operating on 800 MHz, VHF, and UHF public safety mutual aid and interoperability channels exceed the asserted costs to manufacturers of low-power TETRA equipment, which we find to be largely speculative. Additionally, public safety agencies that wish to use non-H Mask compliant digital emissions for non-interoperable communications may apply for 800 MHz interleaved spectrum, including an additional 4.5 MHz of public safety spectrum, which is not subject to interoperability requirements.

C. Estimate of the Number of Small Entities To Which the Proposed Rules Will Apply

8. The RFA directs agencies to provide a description of, and, where feasible, an estimate of, the number of small entities that may be affected by the rules adopted herein.⁵ The RFA generally defines the term “small entity” as having the same meaning as the terms “small business,” “small organization,” and “small governmental jurisdiction.”⁶ In addition, the term “small business” has the same meaning as the term “small business concern” under the Small Business Act.⁷ A “small business concern” is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the Small Business Administration (SBA).⁸

9. *Private Land Mobile Radio Licensees.* PLMR systems serve an essential role in a range of industrial, business, land transportation, and public safety activities. These radios are used by companies of all sizes operating in all U.S. business categories, and are often used in support of the licensee's primary (non-telecommunications) business operations. For the purpose of determining whether a licensee of a PLMR system is a small business as defined by the SBA, we use the broad census category, Wireless Telecommunications Carriers (except Satellite).

10. The Wireless Telecommunications Carriers (except satellite) industry comprises establishments engaged in operating and maintaining switching and transmission facilities to provide communications via the airwaves. Establishments in this industry have spectrum licenses and provide services using that spectrum, such as cellular phone services, paging services, wireless Internet access, and wireless video services.⁹ The appropriate size standard under SBA rules for the category Wireless Telecommunications Carriers (except satellite) is that a business is small if it has 1,500 or fewer employees.¹⁰ Census data for 2007 show that there were 1,383 firms that operated for the entire year.¹¹

⁵ 5 U.S.C. § 604(a)(3).

⁶ 5 U.S.C. § 601(6).

⁷ 5 U.S.C. § 601(3) (incorporating by reference the definition of “small-business concern” in the Small Business Act, 15 U.S.C. § 632). Pursuant to 5 U.S.C. § 601(3), the statutory definition of a small business applies “unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register.”

⁸ 15 U.S.C. § 632.

⁹ U.S. Census Bureau, North American Industry Classification System, Definition of “Wireless Telecommunications Carriers (except Satellite),” NAICS code 517210, available at <<http://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517210&search=2007%20NAICS%20Search>>

¹⁰ See 13 C.F.R. 121.201, NAICS Code 517210

Of this total, 1,368 firms had employment of fewer than 1000 employees.¹² Thus under this category and the associated small business size standard, the Commission estimates that the majority of wireless telecommunications carriers (except satellite) are small.¹³

11. The definition of the Wireless Telecommunications Carriers (except satellite) industry provides that a small entity is any such entity employing no more than 1,500 persons.¹⁴ The Commission does not require PLMR licensees to disclose information about number of employees, so the Commission does not have information that could be used to determine how many PLMR licensees constitute small entities under this definition. We note that PLMR licensees generally use the licensed facilities in support of other business activities, and therefore, it would also be helpful to assess PLMR licensees under the standards applied to the particular industry subsector to which the licensee belongs.¹⁵

12. As of November 1, 2012, there were 1,185 PLMR licensees operating in the PLMR band between 806-809/851-854 MHz (NPSPAC band) and 686 PLMR licensees operating on the VHF and UHF public safety interoperability channels. We note that any entity engaged in a commercial activity is eligible to hold a PLMR license, and that any revised rules in this context could therefore potentially impact small entities covering a great variety of industries.

13. *Small Businesses, Small Organizations, and Small Governmental Jurisdictions.* Our action may, over time, affect small entities that are not easily categorized at present. We therefore describe here, at the outset, three comprehensive, statutory small entity size standards that encompass entities that could be directly affected by the proposals under consideration.¹⁶ As of 2009, small businesses represented 99.7% of the 28.2 million businesses in the United States, according to the SBA.¹⁷ Additionally, a “small organization” is generally “any not-for-profit enterprise which is independently owned and operated and is not dominant in its field.”¹⁸ Nationwide, as of 2007, there were approximately 1,621,315 small organizations.¹⁹ Finally, the term “small governmental jurisdiction” is defined generally as “governments of cities, counties, towns, townships, villages, school districts, or special districts, with a population of less than fifty thousand.”²⁰ Census Bureau data for 2007 indicate that there were 89,527 governmental jurisdictions in the United States.²¹ We estimate that, of this total, as many as 88,761

(Continued from previous page)

¹¹ U.S. Census Bureau, 2007 Economic Census of the United States, Table EC0751SSSZ5, Information: Subject Series - Estab and Firm Size: Employment Size of Firms for the United States: 2007, NAICS Code 517210, available at http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ECN_2007_US_51SSSZ5&prodType=table

¹² Id. Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees. The largest category provided is for firms with “1,000 employees or more”.

¹³ Id.

¹⁴ See 13 C.F.R. § 121.201, NAICS code 517210.

¹⁵ See generally 13 C.F.R. § 121.201.

¹⁶ See 5 U.S.C. § 601(3)–(6).

¹⁷ See https://www.sba.gov/sites/default/files/FAQ_March_2014_0.pdf (March 2014).

¹⁸ 5 U.S.C. § 601(4).

¹⁹ INDEPENDENT SECTOR, THE NEW NONPROFIT ALMANAC & DESK REFERENCE (2010).

²⁰ 5 U.S.C. § 601(5).

²¹ U.S. CENSUS BUREAU, STATISTICAL ABSTRACT OF THE UNITED STATES: 2011, Table 427 (2007).

entities may qualify as “small governmental jurisdictions.”²² Thus, we estimate that most governmental jurisdictions are small.

14. *RF Equipment Manufacturers.* The Census Bureau defines this category as follows: “This industry comprises establishments primarily engaged in manufacturing radio and television broadcast and wireless communications equipment. Examples of products made by these establishments are: transmitting and receiving antennas, cable television equipment, GPS equipment, pagers, cellular phones, mobile communications equipment, and radio and television studio and broadcasting equipment.”²³ The SBA small business size standard for Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing is all such firms having 750 or fewer employees.²⁴ According to Census Bureau data for 2007, there were a total of 939 establishments in this category that operated for the entire year.²⁵ Of this total, 912 had employment of under 500, and an additional 10 had employment of 500 to 999.²⁶ Thus, under this size standard, the majority of firms can be considered small.

D. Description of Projected Reporting, Recordkeeping, and Other Compliance Requirements

15. The *Report and Order* adopts two principal rule changes that will affect reporting, recordkeeping and other compliance requirements. The *Report and Order* retains our 800 MHz NPSPAC emission mask rules and explicitly requires digital emission transmitters, including, but not limited to TETRA-based technologies, to comply with Emission Mask H when operated on 800 MHz NPSPAC channels. The *Report and Order* also requires mobile and portable transmitters to have analog FM

²² The 2007 U.S. Census data for small governmental organizations are not presented based on the size of the population in each such organization. There were 89,476 local governmental organizations in 2007. If we assume that county, municipal, township, and school district organizations are more likely than larger governmental organizations to have populations of 50,000 or less, the total of these organizations is 52,095. If we make the same population assumption about special districts, specifically that they are likely to have a population of 50,000 or less, and also assume that special districts are different from county, municipal, township, and school districts, in 2007 there were 37,381 such special districts. Therefore, there are a total of 89,476 local government organizations. As a basis of estimating how many of these 89,476 local government organizations were small, in 2011, we note that there were a total of 715 cities and towns (incorporated places and minor civil divisions) with populations over 50,000. CITY AND TOWNS TOTALS: VINTAGE 2011 – U.S. Census Bureau, *available at* <http://www.census.gov/popest/data/cities/totals/2011/index.html>. If we subtract the 715 cities and towns that meet or exceed the 50,000 population threshold, we conclude that approximately 88,761 are small. U.S. CENSUS BUREAU, STATISTICAL ABSTRACT OF THE UNITED STATES 2011, Tables 427, 426 (Data cited therein are from 2007).

²³ U.S. Census Bureau, 2007 NAICS Definitions, “334220 Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing”; <http://www.census.gov/econ/industry/def/d334220.htm>.

²⁴ See 13 C.F.R. § 121.201, NAICS code 334220.

²⁵ U.S. Census Bureau, 2007 Economic Census, 2007 Economic Census of Island Areas, and 2007 Nonemployer Statistics; <http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?ftp=table>. The number of “establishments” is a less helpful indicator of small business prevalence in this context than would be the number of “firms” or “companies,” because the latter take into account the concept of common ownership or control. Any single physical location for an entity is an establishment, even though that location may be owned by a different establishment. Thus, the numbers given may reflect inflated numbers of businesses in this category, including the numbers of small businesses. In this category, the Census breaks-out data for firms or companies only to give the total number of such entities for 2007, which was 844. <http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?ftp=table>

²⁶

http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ECN_2007_US_31SG3&prodType=table. An additional 17 establishments had employment of 1,000 or more.

modulation capability on the public safety mutual aid and VHF/UHF interoperability frequencies. Digital emission transmitters have characteristics that differ from analog FM transmitters and, hence, have a greater likelihood of causing adjacent-channel interference. The Commission developed specific emission masks for digital emissions, including Mask H for digital emissions in the 800 MHz NPSPAC band. Industry practice recognizes that (1) digitally-modulated signals must be certified under the H-Mask for use in public safety spectrum and (2) radios intended for use on mutual aid and interoperability channels must be capable of analog FM operation. We expect that large and small manufacturers already comply with these proposed regulations. However, to the extent some manufacturers do not already comply with these regulations and industry standards, we expect that such manufacturers would refrain from marketing their equipment to public safety entities as being in compliance with the Commission's rules and ensure that their equipment performs consistent with these regulations designed to prevent interference and preserve interoperability. The Commission's equipment certification process will serve to ensure that equipment complies with Emission Mask H when operated in the NPSPAC band and that it has FM modulation capability on public safety mutual aid and VHF/UHF interoperability frequencies. Some manufacturers may submit new or amended applications for equipment certification accompanied by the requisite engineering showings that demonstrate compliance with the rules adopted in the *Report and Order*. See OMB Control No. 3060-0057.

E. Steps Taken To Minimize Significant Economic Impact on Small Entities, and Significant Alternatives Considered

16. The RFA requires an agency to describe any significant alternatives that it has considered in developing its approach, which may include the following four alternatives (among others): “(1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance and reporting requirements under the rule for such small entities; (3) the use of performance rather than design standards; and (4) an exemption from coverage of the rule, or any part thereof, for such small entities.”²⁷

17. We have evaluated our rule changes in the context of small business entities and find no alternatives, to the benefit of small entities that would achieve our goals of adjacent channel interference avoidance and facilitating nationwide interoperability. Additionally, the rules we adopt are consistent with industry practice and reflect the embedded base of public safety equipment on these channels. Accordingly, we expect most manufacturers and public safety licensees already comply with our regulations, therefore minimizing any significant economic impact on small entities. We believe that these restrictions on adjacent channel interference and interoperability compliance requirements are the minimum needed, when weighed against the significant benefits to small entities, including public safety entities, that result from the approach we are adopting here. In order to further minimize the economic impact on small entities, the rules provide analog FM capability only in subscriber units in order to achieve interoperability.

F. Federal Rules that May Duplicate, Overlap, or Conflict With the Proposed Rules

18. None.

²⁷ 5 U.S.C. § 603(c)(1) – (c)(4).

G. Report to Congress

19. The Commission will send a copy of the *Report and Order*, including this FRFA, in a report to be sent to Congress pursuant to the Congressional Review Act.²⁸ In addition, the Commission will send a copy of the *Report and Order*, including this FRFA, to the Chief Counsel for Advocacy of the SBA. A copy of the *Report and Order* and FRFA (or summaries thereof) will also be published in the Federal Register.²⁹

²⁸ See 5 U.S.C. § 801(a)(1)(A).

²⁹ See 5 U.S.C. § 604(b).

APPENDIX C**List of Commenters****I. Comments**

Association of Public Safety Communications Officials, International, Inc. (APCO)
Harris Corp. (Harris)
Motorola Solutions, Inc. (MSI)
National Public Safety Telecommunications Council (NPSTC)
New Jersey Transit Corp. (NJ Transit)
PowerTrunk, Inc. (PowerTrunk)
NPSPAC Region 13
Telecommunications Industry Association (TIA)

II. Reply Comments

APCO
Harris
PowerTrunk
NPSPAC Region 8 (Region 8)

III. *Ex Parte* Filings

APCO (Dec. 2, 2013) (Apr. 7, 2016)
Harris Corp. (Dec. 17, 2013, Feb. 5, 2014, May 12, 2014)
PowerTrunk (Nov. 11, 2013, Dec. 18, 2013, Jan. 28, 2014, Apr. 29, 2014, May 21, 2014, July 22, 2015)
TIA (Feb. 4, 2014) (Mar. 29, 2016)

**STATEMENT OF
COMMISSIONER MICHAEL O'RIELLY
APPROVING IN PART, CONCURRING IN PART**

Re: Emission Mask Requirements for Digital Technologies on 800 MHz NPSPAC Channels; Analog FM Capability on Mutual Aid and Interoperability Channels, PS Docket No. 13-209, RM-11663, Report & Order

For the most part, I am generally supportive of today's action that will help guard against interference and promote interoperable communications in certain public safety bands. I must concur, however, to two sections of this item.

First, I largely oppose any type of technology mandate. Today's item requires that all public safety radios operating on the 800 MHz, VHF and UHF mutual aid and interoperability bands must have analog FM capability. While I understand the pursuit of interoperability on interoperability channels, industry, despite not having a technology requirement, has adopted FM analog as the *de facto* standard in these bands. Therefore, this requirement seems unnecessary. In fact, what happened here is the preferable approach – industry determined the best means to produce interoperability. Once a technology is set in regulatory stone, innovation and investment may be deterred or, if a better technology is or becomes available, it could take years to update our rules to reflect such advancements. And, frankly, it seems ridiculous in today's digital world to be requiring that devices have less efficient, analog technology.

Second, I continue to have deep concerns about the cost-benefit analyses contained in the Commission's items. While I appreciate that staff took my concerns into consideration and made changes to this section, this item still lacks a quantitative assessment of the actual costs and benefits of our actions. Simply put, the Commission has the responsibility to conduct such a review and yet it does not sufficiently do so, which I cannot fully support.

As long as the Commission continues to shirk its obligations, I reiterate my plea to stakeholders that they inform our analysis by providing data about the cost savings of their proposals or the possible costs of Commission rules. This will assist the Commission in weighing the cost and benefits and, ultimately, inform whether regulatory actions are justified.